

PERG ANIMAL SYSTEM

Evoked Potential Acquisition System
Software Manual Version 2.10



JÖRVEC

JÖRVEC

Telephone: (305) 668-6102 • Fax: (305) 668-6103

E-mail: info@jorvec.com

Web: <http://www.jorvec.com>

PERG Software Manual

Evoked Potential Acquisition System
Software Manual Version 2.10

©2015 Intelligent Hearing Systems

Revision: October 14, 2015
Part Number: M010010

Manufacturer:

Intelligent Hearing Systems
6860 SW 81st St
Miami, FL 33143
U.S.A.

Table of Contents

System Information and Setup

- 1. Introduction..... 6
- 2. Initial Setup.....8

User’s Guide

- 3. Workflow.....14
- 4. Subject File Management..... 15
- 5. Subject Preparation20
- 6. Parameters for Acquisition22
- 7. Data Acquisition.....31
- 8. Data Processing.....33
- 9. Managing Recordings41

Menu and Function Reference

- 10. Managing Recordings.....48
- 11. Main Menu.....54
- 12. Additional Windows.....60

Appendices

- 13. Troubleshooting.....65



System Information and Setup

Introduction

1



Congratulations on the purchase of Intelligent Hearing Systems (*IHS*) equipment. In order to obtain maximum benefit and safety from your system, please be sure to read all the enclosed documentation. If you have any questions as you read these instructions, please contact our customer service department or your local dealer.

Indications for use

The PERG Research software is intended for research use on Animals only..

Contraindications

There are no known contraindications for use of IHS software and related hardware.

Operating System Requirements

The PERG Research Software works with the Windows® 10, Windows® 8, and Windows® 7 operating systems. This manual assumes that user is familiar with these operating systems and their capabilities. Please refer to the operating system manuals or help systems when necessary.

Product Installation

Please refer to the installation manual for installation instructions. Installation instructions can also be viewed in electronic format (*PDF*); the files can be found inside the provided software installation media drive. Adobe Acrobat Reader® is needed to open PDF files, the free Acrobat Reader® can be downloaded from Adobe Systems at <http://www.adobe.com>.

Hardware considerations

The functionality of the software will be dependent on the hardware that is being used in combination with it. The Universal Smart Box (*USB Box*), Universal Smart Box Jr. (*USB Jr.*), and Universal Smart Box Lite (*USBLite*) will have different capabilities when it comes to the addition of software and hardware modules or modalities due to their physical characteristics.

USB Box capabilities within PERG:

- Up to 2 channels of acquisition
- User selectable filters, gain, and notch filter.
- Electrode impedance measured using the Opti-Amp Transmitter.

Customer responsibility

The equipment, its components, and included software will perform reliably when it is operated and maintained according to the instructions within these manuals, equipment labels, and enclosed documentation. Defective components must not be used and broken, worn, or missing parts should be replaced promptly with new IHS manufactured or repaired parts. If you believe any part of the equipment is defective or if you need additional information, please contact IHS.

The responsibility of IHS is limited by the warranty as stated in the technical reference manual. Should the repair or replacement of the product become necessary after the end of the warranty period, the user must consult IHS before such repair or replacement. If the product is in need of repair, do not use it until all repairs are completed, the unit is functioning properly, and is appropriately tested. The owner of this product has sole responsibility for the following:

- Any malfunction resulting from improper use,
- Maintenance or repairs done by anyone other than IHS authorized personnel,
- Any malfunction caused by parts that are damaged or modified by anyone other than IHS authorized personnel.

Equipment classification

All IHS hardware, including the USB Box, USB Jr., and USBLite, are classified as follows:

- **Class of Protection:** Class II (IEC 601).
- **Type of Protection:** Type BF (IEC 601)

Refer to the technical reference manual for additional information.

Initial Setup

Hardware connections



It is highly recommended to verify all hardware connections before turning ON the unit, starting up the PERG software, and/or connecting to a subject. The following checklist gives you an outline of the possible connections that should be verified before usage. Not all items in this list apply to every hardware type.

1. Verify the hardware unit power:
 - The USB Power Supply for the USB Box should be connected to an outlet using a medical grade power cord. The USB power supply should be securely connected to the USB Box using the 5-pin power connector.
2. The Opti-Amp transmitter should be connected to the USB Box using the fiber optic cable, one optical port per EP channel, and the 3-pronged power cable.
3. If using a laptop computer to run the software, it is advised that you keep the laptop pulled in with the provided power supply at all times.
4. Connect the IHS hardware to the computer:
 - Connect the USB Box to one of the computer's USB ports using the provided cable.
5. Connect the PERG stimulus display tablets to the power outlet and to the USB box using the included DB25 cables. Each Stimulus display requires its own power supply. Please refer to the PERG Animal Holder assembly guide (M014763) for details.

Starting the PERG software

A shortcut to the PERG software should be available from a desktop shortcut, or from the Windows Start Menu. You can also choose to create a shortcut directly to the PERG program as follows:

1. Use Windows Explorer to browse your computer's 'C' drive and find the PERG installation folder, by default, the name of this folder is "**PERG**".

2. Inside the installation folder find the program called **“PERGmouse.EXE”**. Use a right mouse-click over the program to open the context menu. *(Keep in mind that depending on local settings, some computers may not show known file extensions like “.EXE”, in that case the file name would only show as “PERGmouse”).*
3. From the context menu, select **[Send to > Desktop]**.
4. Close the explorer window and rename your new desktop icon as needed.

Program layout

The following image shows the general layout of the PERG program.

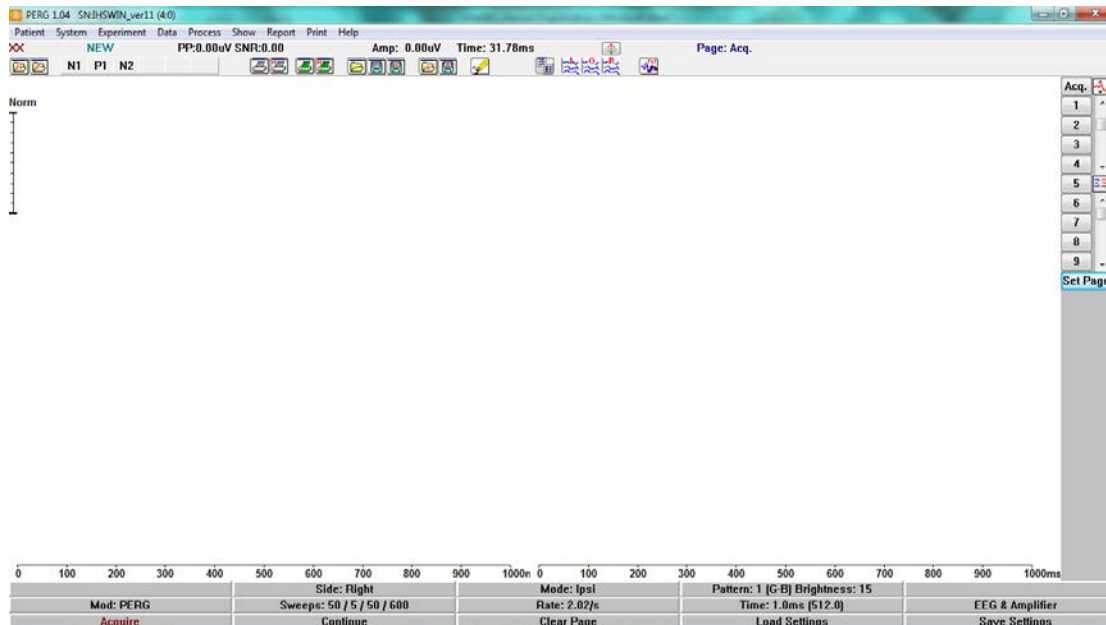


Fig. 1. - PERG Main Window

These are the names of the different areas of PERG and their descriptions, starting from the top left:

- **Title Bar:** The Title Bar is the top-most blue bar shown on Fig. 1. This bar contains the name of the program, software version number, system serial number (as SN:IHSXXXX), and hardware identification (as hardware type code and hardware serial number).
- **Main Menu:** The menu bar is located right under the Title Bar and allows access to almost all functions of the program. The items shown in the main menu will vary based on system configuration. Descriptions of all items in the main menu can be found in the Main Menu section of this manual.
- **Indicator Bar:** It is located below the Main Menu and contains some general information about the currently loaded patient file and selected response. From left to right, the indicator shows:
 - The patient identifier,
 - Recording name,
 - Peak-to-peak amplitude,
 - Signal-to-noise ratio,
 - Residual noise,
 - Mouse pointer amplitude position,
 - Mouse pointer time position,
 - Show/hide tool bar button, and
 - Current display page.
- **Tool Bar:** Below the indicator line, there is a tool bar that houses buttons equivalent to the most commonly used menu items. It contains buttons for patient files, peak markings, printing, data load and save, report load and save, organizing recordings, and filtering. See the Main Screen section of this manual for a detailed description. The tool bar can be turned ON and OFF using the **[Show/Hide]** button in the Indicator Bar.
- **Recording Area:** The large white area at the left and center of PERG software. This area contains all recordings acquired or loaded. There is a time scale at the bottom of this area. At the top left, a vertical scale marker shows the current

scale, it can be set to a specific microvolt scale or normalized. There are ten recording display areas in the software, one per report page and accessible from the side menu; only one of them can be viewed at a time.

- **Control Panel:** This collection of buttons contains the most frequently used acquisition controls and resides at the bottom of the screen; it is only present while on the acquisition page (Acq.) From here you can also access other controls such as the EEG and Amplifier window, or adjust the recording parameters.
- **Side Menu:** It is located to the right of the recording area. It shows buttons corresponding to the acquisition page and the other 9 report pages. It also contains buttons for setting page display parameters and to show/hide the recording information panel and the EEG Panel.

Keyboard shortcuts

The following keyboard shortcuts can be used to access certain functions in the PERG software.

- **[Esc]:** It can be used to pause or stop a recording.
- **[Space]:** It can be used to pause or stop a recording.
- **[A] or [0]:** Switches the display to the acquisition page.
- **[1] through [9]:** Switches the display to the correspondingly numbered page.
- **[P]:** Displays the Set Page menu.
- **[+]:** Adds all the currently selected recordings into a new data buffer (average).
- **[-]:** Subtracts the two selected recordings and places the result into a new data buffer (average).

Settings

The PERG software comes pre-loaded with a set of default acquisition settings. These default values can be loaded by clicking on the **[Load Settings]** button on the Control Panel and selecting the 'PERG.SET' file. Depending on your preferences you may wish to change the acquisition parameters using the Control Panel buttons to fit your needs. After this, you can save the new settings using the **[Save Settings]** button on the Control Panel.



Caution:

Always check the default settings before starting acquisition, especially in multi-user environments. Other users may have modified the default parameters without your knowledge.

As with any other data stored in your computer it is a good idea to keep backup copies of the settings files, especially if you do not keep printed records of the values used. The settings files can be found inside the **"C:/PERG/Settings_PERG"** folder.



User's Guide

Workflow

3



The following are the expected work-flows, on a day-to-day basis, when using PERG software for evoked potential acquisition. The outlined steps, including specific menu items and buttons to use, are explained in detail in their corresponding chapters of this

Single session workflow

1. Verify all hardware connections, making sure all the required equipment for the type of test is connected.
2. Check the device and accessories for cleanliness; refer to the hardware installation manual for more information about cleaning and maintenance, if necessary.
3. Turn ON the equipment and computer.
4. Open the PERG program.
5. Create new subject file in the PERG program. See ***“Creating a new patient file”*** on page 15 for details. Or load an existing patient file.
6. Change the software modality and testing parameters as needed, or load a previously saved settings file. See ***“Suggested acquisition parameters”*** on page 27 for details about modalities and their parameters.
7. Prepare the subject by placing electrodes and stimulators as necessary..
8. Modify levels and other parameters as needed and continue with acquisition until all the required data is acquired.
9. Once done, and satisfied with the acquired data, release the patient by removing electrodes and stimulators.
10. Finish arranging the recordings on the pages. See ***“Moving recordings”*** on page 42
11. Label recordings with corresponding peak labels.
12. Save the data as a report to allow for easy retrieval in the future, then print pages if needed for your records, or save as a PDF document if keeping electronic records.
13. Exit the software
14. Turn OFF all devices and computer if finished for the day.
15. Clean the devices and accessories as needed.
16. Store device, accessories, and disposables in a clean secure area.

Multi-session workflow

In some instances, when time constrained for time or due to other complications, it may be necessary to span a test over several sessions; for example, when performing a multi-frequency threshold search. To test over multiple sessions, follow the standard workflow for the first session, and then do the following for each of the sessions after that:

1. Follow steps 1 to 3 of the standard workflow. Verifying the hardware connections, equipment cleanliness, and turning the equipment ON.
2. Open the existing subject file from the PERG software.
3. Load the previously saved report (*see step 12 of the standard workflow*).
4. Follow steps 6 to 12 of the standard workflow. Checking the acquisition parameters, preparing the subject, acquiring the needed data, and organizing the newly acquired recordings.
5. Save the report with the same name as before to update it (*or different name if keeping track of changes*), then print pages or save to PDF as needed.
6. Continue with the standard workflow from step 16 to the end. Turning off the devices, cleaning as needed, and placing them in the appropriate storage location.

Subject File Management

4



Subject files

Every time there is a new patient or test subject, a subject file should be created. The subject file holds the demographic information including identification numbers and other important details about the subject. Upon creation, a new folder is generated in the 'PERGData' folder; this subject folder will have the same name as the assigned patient identifier and will contain all data, reports, and digital documents for that patient.

Creating a new subject file

To create a new subject file:

1. From the main menu, click on [Patient > New].

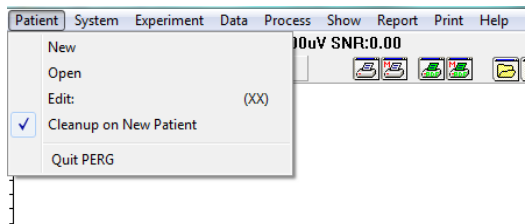


Fig. 2. - PERG Patient menu.

2. You may enter a **"Patient Identifier"**, or leave the Identifier that is automatically assigned. The automatic identifier includes the system serial number and a date code. Identification numbers can be used in this field. This field cannot be left blank and it must be unique to that patient. This field is searchable from the patient list window.
3. Enter the **"First Name"** and **"Last Name"**. Both of these fields are required since the patients initials are used when naming the files of acquired recordings. A small hand pointing button indicates that a required field is missing information. Both of these fields are searchable from the patient list. For animal subjects you may use an alphanumeric characters for the First and Last name fields, for instance, a Black 6 mouse could have first name B, last name 6.

Fig. 3. - Detail view of the Patient Demographics window

4. Enter information on the additional fields located on the different tabs as needed. Note that none of those additional fields are required. This can be used to keep track of various experimental variables, such as the genome of the animal tested or whether the subject is a control.
5. Click [OK] to finish.

You will notice that the patient file has been created by looking at the indicator bar. The patient identifier for the file that was just created can be found to the left, shown on dark red letters (*as seen on the image below under the name "DEMODATA"*). When no patient file is currently selected, the identifier will show the text 'XX'. Note that if the identifier is too long, the identifier shown will be truncated.

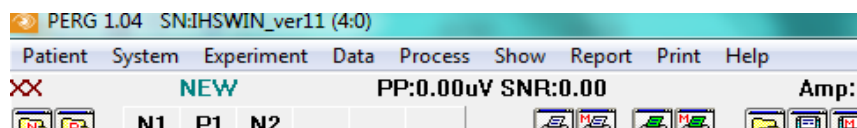


Fig. 4. - Patient Identifier (XX) shown at the left of the Indicator Bar

Loading a subject file

A subject file that has been previously created can be loaded to continue with acquisition or to analyze the pre-acquired data. To load an existing subject file:

1. From the main menu, click on **[Patient > Open]**.
2. The Patient List window will show the list of all patient folders in the 'PERGData' folder. Note that to comply with privacy regulations, first names and last names are hidden; to view, check the **[Show First and Last Name]** box, refer to the Launch Pad manual for instruction on how to modify this behavior.

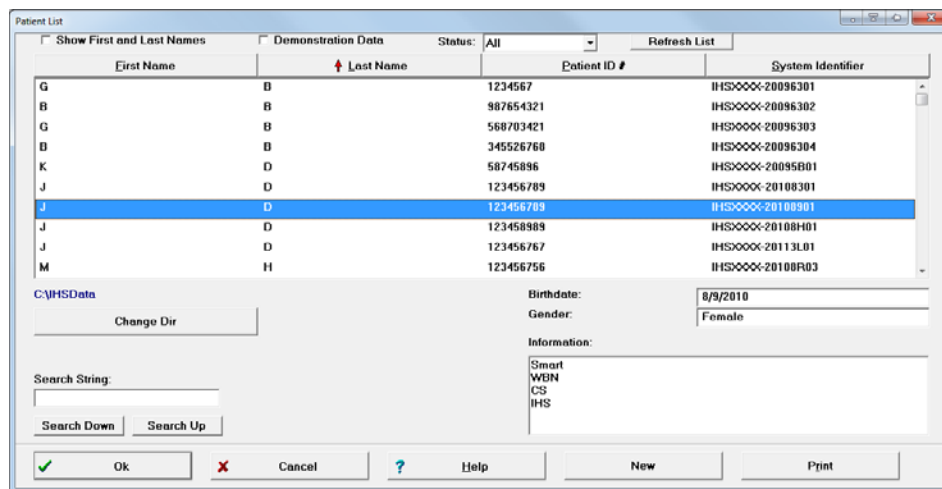


Fig. 5. - Patient List

3. Select the patient file you wish to load. The selected patient file will be highlighted in blue. Use the "Search" field if necessary to find any string in any of the four columns.
4. Click the **[OK]** button to load. The Patient Demographics window will open to confirm your selection.
5. Click **[OK]** again to finish loading the Patient File.

If by any chance the patient you are looking for is not listed, it may be because the patient list is outdated. Simply click on the **[Refresh List]** button at the top right of the patient list window to update it with all the patient folders currently residing in the 'PERGData' folder. If the patient still does not show after refreshing the list, it is possible that the patient was stored to another data directory, outside of the 'PERGData' folder (or the current folder being used for patient file storage.) You may try to locate the patient in another directory using the **[Change Dir]** button.

Editing patient information

Patient demographic information can be edited directly from PERG software:

1. From the main menu, click on **[Patient > Edit]**. Notice the name of the current patient is listed on the menu item.
2. With the Patient Demographics window open, edit the information in the patient fields as needed. Do not change the "Patient Identifier", "First Name" initial, or "Last Name" initial (anything after the initials can be changed); these 3 fields are used for folder and file naming, changing any of these three items may cause previously recorded data to be inaccessible.
3. Click the **[OK]** button to confirm the changes.

Printing Subject Information

All the subject demographic information entered into the system can be printed easily from the PERG software. Once the patient is loaded, click on **[Patient > Edit]** from the main menu, then click on the **[Print]** button on the right hand side of the Patient Demographics window. The information will be sent to the current default printer, make sure to set the printer you want as the Windows default before pressing the **[Print]** button.

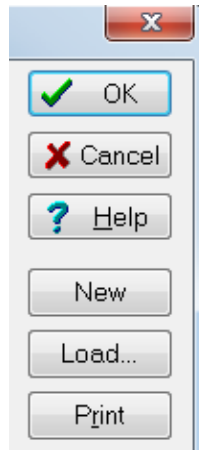


Fig. 6. - Detail view of the Patient Demographics window

Backing up a patient file

Backing Up a single patient file can be done directly from the PERG software. To do this:

1. Open the Patient Demographics window with the patient file that needs to be backed up, then click on the **[Backup]** button on the right hand side of the window. This will open the Backup and Restore Utility with the current patient selected.

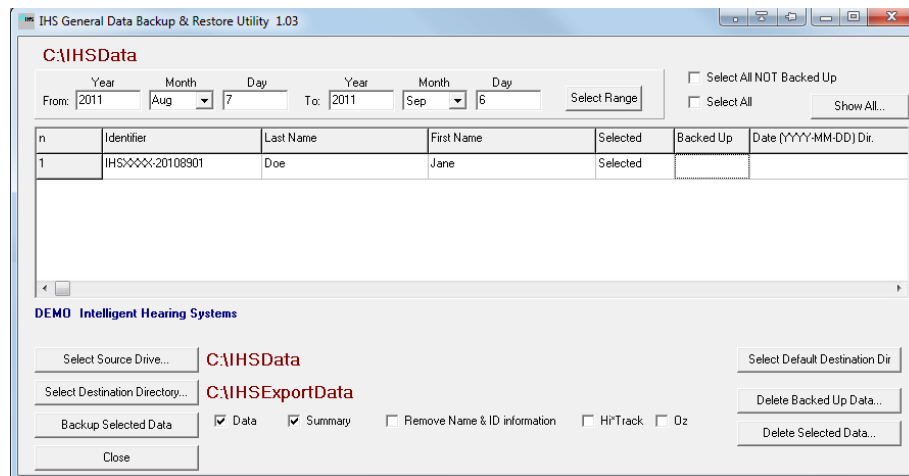


Fig. 7. - Backup and Restore Utility

2. Change the backup options at the bottom of the window as needed, and then press the **[Backup Selected Data]** button when ready.

For additional information about the usage of the Data Backup and Restore Utility, and for instructions on backing up multiple patients, refer to the Launch Pad Manual.



Caution:

If backing up data to send to an unsecured location for review (*including when sending data to IHS*), in order to comply with patient privacy regulations; make sure to have the **'Remove Name & ID Information'** box checked before performing the backup.

Restoring a patient file

To restore a single patient file from the PERG software:

1. Open the Patient Demographics window by clicking on **[Patient > New]** from the PERG main menu (See Fig. 2 on page 10), or one of the patient buttons from the tool bar, then click the **[Backup]** button on the right hand side of that window.
2. When the Data Backup and Restore Utility (see Fig. 7 on page 12), click on the **[Select Source Drive]** button and choose the location of the patient file you want to restore.

3. Click on the [\[Select Destination Directory\]](#) button and choose the 'PERGData' folder in your main drive.
4. Select the patient file from the list by clicking once on the row corresponding to that patient from the list. The cell under the 'Selected' column should now read *"Selected"*.
5. Make sure the 'Data' and 'Summary' boxes are checked, then press the [\[Backup Selected Data\]](#) button.

Refer to the Launch Pad manual for additional details about the Data Backup and Restore Utility and instructions on how to restore multiple patients.

Deleting a patient file



Caution:

Deleting patient data is a permanent operation and cannot be undone. Make sure you have a backup data set before deleting any information from your system..

The entire patient file and related content can be deleted directly from PERG. To do this, open the Patient Demographics window by either loading a patient or clicking on [\[Patient > Edit\]](#) from the main menu, then click on the [\[Delete\]](#) button on the right hand side of the window. You will be asked to confirm the deletion of the patient file.

Subject Preparation

5



Skin preparation for surface electrodes

When using surface electrodes, be it disposable or reusable, it is imperative to achieve good impedance values. This will lead to less recording noise, and more repeatable responses. Here are some recommendations for reducing skin impedance. Make sure you adhere to your institution's standard procedures for skin preparation as they supersede any recommendations IHS may provide:

- **Gently** clean the skin with an alcohol pad to remove excess oil or makeup at the intended electrode placement locations.
- If necessary, **mildly** rub the electrode locations with a soft cloth pad such as gauze and some approved impedance reducing abrasive gel. Be mindful of specific patient needs for skin sensitivity and follow the gel manufacturer's instructions. You want to skip this altogether when the patient is a newborn, small infant, or any patients with extremely sensitive skin.
- When using disposable electrodes, make sure they are not expired. Expired electrodes may result in noisy recordings, bad impedances, or detaching electrodes.
- You may place a small dab of approved conductive gel on the electrode sensor area of the disposable electrodes before placement to improve impedance. Do not use too much gel or it may prevent the electrode from sticking. Letting the electrodes sit in place for a few minutes may help the conductive gel settle and improve impedances.
- Do not press disposable electrodes onto the skin by the sensor area, use the sides of the electrode. Pressing the sensor area may force any conductive gel into the adhesive area, causing the electrode to fail to adhere, or to detach later mid-test.
- When using reusable electrodes such as gold cup electrodes, make sure to use enough conductive paste and then secure them in place by using a small piece of surgical tape. Using a small piece of gauze between the electrode and the surgical tape is recommended.

Smart Tip:

Keep opened bags of disposable electrodes in an air-tight container such as a zip-top bag to extend their shelf-life.

Electrode polarity and activation

The following sections describe the operation of the electrode positions as defined by the settings selected in the PERG software.

Dual channel transmitter for the USB Box.

The dual channel transmitter box has five electrode positions: two **Red**, two **Blue**, and one **Black**. In These type of transmitters, the **Red** positions are always the inverting electrodes, the **Blue** positions are always the non-inverting electrodes, and the **Black** position is always the ground. The polarity of the electrode positions will not change regardless of software settings. Channel designation can be changed in the EEG and Amplifier window independent of channel label (A, B, C, etc...); each channel can be defined as right, left, ON, or OFF. The software will decide which channel to acquire from based on this designation and the parameters specified for ear and mode in the control panel.

Recording Mode	Ipsilateral			Contralateral			Both
Stimulation	Right	Left	Both	Right	Left	Both	R, L or B
Designation: Right	Yes	-	Yes	-	Yes	Yes	Yes
Designation: Left	-	Yes	Yes	Yes	-	Yes	Yes
Designation: ON	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Designation: OFF	-	-	-	-	-	-	-

Table 2. - Channels that acquire; based on Designation, Stimulation Side and Mode of Acquisition.

Normally Channel A is designated to be the Right channel, while Channel B is designated to be the Left channel. As an example, if you set the recording mode to '**Ipsilateral**', and the stimulation ear to be '**Right**'; then as shown on the table, only channels designated as '**Right**' or '**ON**' will acquire. Then in this example, only Channel A will acquire while Channel B will not.

Electrode locations

The following are recommendations for electrode placement. Keep in mind that different protocols may call for electrode locations other than the ones shown in this manual. Generally, using a different location will yield results and waveforms with slight variations in morphology. It is recommended to choose a particular setup for your studies, and always use the same setup to keep results consistent.

Snout electrode placement

One of the unique advantages of the PERG animal system is the ability to extract both the left and right eye response from a single needle electrode montage avoiding conventional electrodes which make direct contact with the subject's eye and are often difficult to place and to maintain. The active needle electrode is placed directly under the skin of the snout and is connected via a 'Y'-Adaptor to the positive terminal of both the A and B channels. The reference needle electrode is placed under the skin between the ears of the mouse and is connected to the negative terminal of both A and B channels using another 'Y'-Adaptor. The Ground electrode is placed in the leg or at the base of the tail of the subject and is then connected to the ground terminal of the amplifier (**Note, electrode colors DO NOT need to match those designated in the figure**)

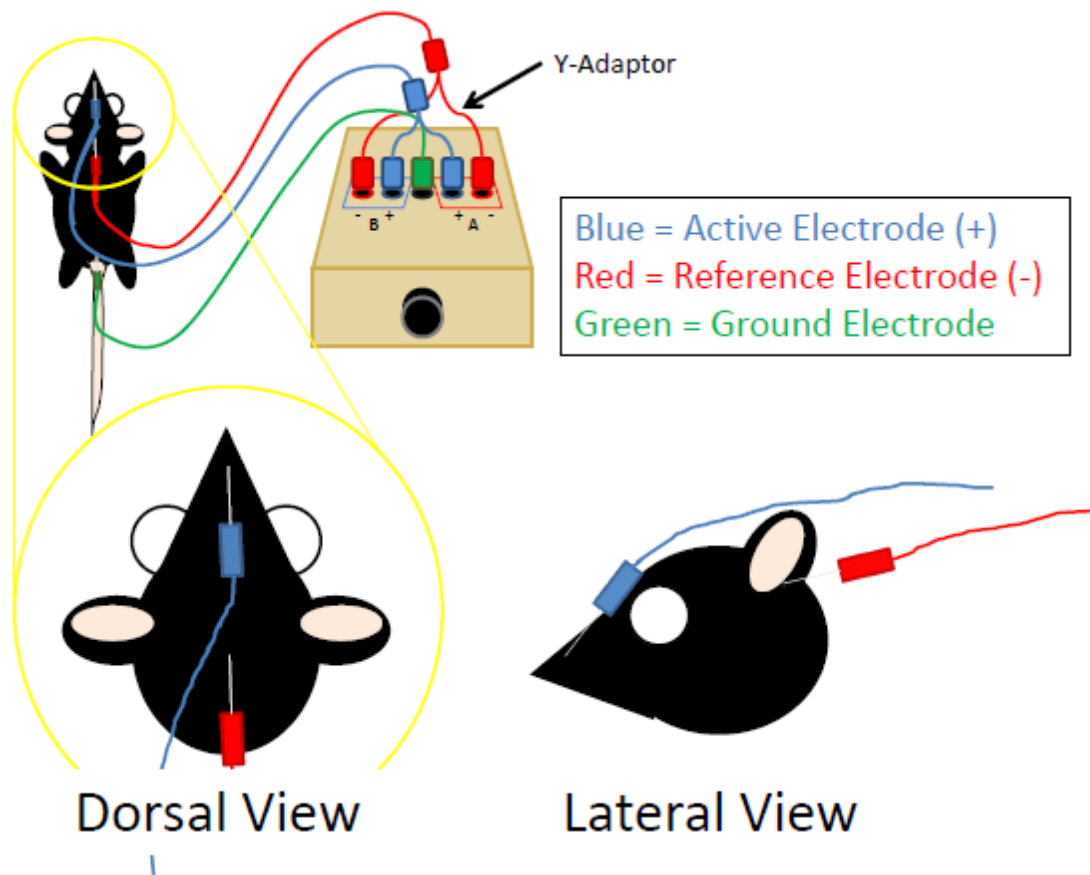


Fig. 12.- Needle Electrode for Mice studies

Checking electrode impedance

The different hardware platforms have their own procedure for checking impedances. All impedances are measured in Ohms. To obtain significant, clean, and repeatable responses it is better to have impedances close to 1 kOhm. Since the hardware is based on differential amplifiers, it is also better to have impedances that match across each channel; that is to say, it is better to have both the non-inverting and inverting electrodes with an impedance of 3 kOhms than having one at 5 kOhms while the other is at 1 kOhms.

Dual channel transmitter

The impedances for the dual channel transmitter can be checked from the device, by moving the rotary switch to the different positions. There are four positions, two per channel. As you check impedances, observe the colored LED's for impedance values, green values are good, yellow are marginal, and orange are to be avoided. After checking impedances and before starting acquisition, make sure to set the rotary switch to the ON position. If a single impedance value is registering high, check the corresponding electrode. If impedance values are high for all electrodes, the black ground electrode is the one affected.

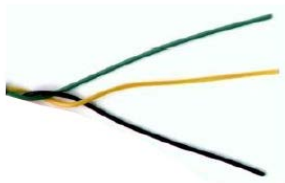


Fig. 13.- Front panel of the dual channel transmitter

Reducing noise for evoked potential acquisition

Evoked Potentials are very small electrical signals measured in the microvolt range, that is one-millionth of one volt. Due to the small amplitude of the signals, they are highly susceptible to external noise contaminants. The following is a list of recommendations to reduce noise for EP testing in general. Try to implement as many of these as possible.

- Make sure all the equipment is connected to the same earth ground. This includes all non-IHS equipment electrically connected to the computer. All non-grounded connections should be removed before starting acquisition. Network computers may need to be disconnected from the network while acquiring.
- Non-essential monitors or equipment connected to the patient should be turned off or disconnected from the patient if possible. Get physician or hospital approval before disconnecting any equipment. **Never disconnect essential equipment from the patient.**
- Try to avoid the use of heating pads, cooling pads, or any other electrical devices where the patient is located. Chairs or beds with electrical motors may need to be turned off. Devices that use wireless technology (*such as bluetooth*) should be turned off. **This does not apply to the provided DC temperature controller used for animal studies.**
- Keep any and all electrical cables away from electrode leads. Any cables crossing the leads may cause artifacts or recording noise.
- Braid the electrode leads together to reduce possible antenna effects and electromagnetic interference.



- Keep CRT monitors away from the electrode leads.
- Never use expired disposable electrodes, expired conductive paste, or visibly-compromised electrode leads.
- Slight changes in the rate of acquisition may cause some noise components to minimize and sometimes disappear as the average is accumulated. Large changes in the rate may also reduce the noise, but could result in a very different wave morphology; diminishing some peaks while accentuating others.

Parameters for Acquisition

6



Modifying testing parameters

Control panel settings

The most commonly modified testing parameters are easily accessible from the PERG control panel. The recommended values for these parameters are found later in this section.

- The **[Side]** button will control which display will currently be used to deliver stimuli.
- The **[Mode]** alters the association of Channel A and B. **For PERG it should be kept at Ipsi.**
- The **[Pattern]** button opens the Pattern Selection widow, allowing the user to alter the parameters of the PERG stimulus.
- The **[Sweeps]** button is followed by 4 numbers. These numbers correspond to the following fields: **[Baseline Sweeps]**, **[Onset Sweeps to Reject]**, **[Sweep Block Size]** and **[Total Sweeps to Acquire]**.
- The **[Rate]** button allows the user to alter the stimulation rate (reversals/sec) of the stimulus. **Note: In some modes of operation, this value is fixed.**
- The **[Time]** button will determine the about of time between data points in the acquisition buffer.
- The **[EEG and Amplifier]** button will open EEG and Amplifier Settings window, allowing the user to view the raw signal acquired by the amplifier and alter the filter and gain settings.
- The **[Acquire]** button will start and being a recording with the currently set Acquisition parameters.
- The **[Continue]** button allows the user to continue a paused acquisition.
- The **[Clear Page]** button clears all the traces from the current page (**This does NOT delete the responses from the Hard Disk**)
- The **[Load Settings]** button allows the user to load a saved settings file.
- The **[Save Settings]** button saves the currently set acquisition parameters as a settings file.

	Side: Right	Mode: Ipsi	Pattern: 1 (G-B) Brightness: 15	
Mod: PERG	Sweeps: 50 / 5 / 50 / 600	Rate: 2.02/s	Time: 1.0ms (512.0)	EEG & Amplifier
Acquire	Continue	Clear Page	Load Settings	Save Settings

Fig. 15. - PERG Control Panel

Understanding Time and Scale

The **[Time]** value defines the time distance between samples in the recorded response. If the Time value is set to 25.0 μ s, then a sample will be taken every 25 microseconds. Given that each recording in the PERG software has 1024 data, this value will determine the length of each trace.

Generally, this setting will be changed automatically to an appropriate value when choosing the acquisition mode; making manual changes to this value rarely necessary. When changed, the value of the **[Time]** button will also modify the horizontal scale of the page automatically.

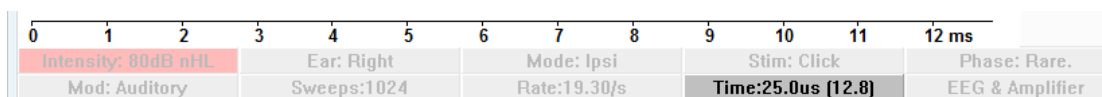


Fig. 16. - Time button and relating to Scale

As a rule of thumb, make the Time (μ s) value a little more than double of the amount of data needed, rounding up at least to the next multiple of 25. For example, if there is need for 80 ms of post-stimulus data, make the Time value at least 175; that is to say double the value (160) rounded up to the next 25 μ s increment; where 25 μ s is the minimum step size for this value.

If the time setting is changed after there are some recordings on the page, the recordings will either get trimmed if the plot time is reduced, or shrunk if the plot time is extended. Changing the time setting after acquisition will not modify a recording or it's resolution, only the region displayed. To change the scale after changing the time setting, use the **[Plot Start]** and **[Plot End]** parameters on the **[Set Page]** pop-up menu.

Saving settings files

Once all settings are defined, the acquisition settings can be saved to a file for later use. Simply click on the **[Save Settings]** button at the bottom right hand side of the control panel. If the settings will be used commonly, keep the name of the file as 'PERG.SET'; this will cause the settings to load at start-up. Otherwise, make sure to give the settings

file a descriptive name. Always keep all settings files to be used in the 'Settings_EP' folder. As a precaution, it is a good idea to make a backup of this folder once you have defined settings files.

Choosing the stimulus

The stimulus options can be accessed by clicking on the **[Pattern]** button from the Control Panel, opening the PERG Pattern Selection window. This window contains all options related to the stimulus output

	Side: Right	Mode: Ipsi	Pattern: 1 (G-B) Brightness: 15	
Mod: PERG	Sweeps: 50 / 5 / 50 / 600	Rate: 2.02/s	Time: 1.0ms (512.0)	EEG & Amplifier
Acquire	Continue	Clear Page	Load Settings	Save Settings

Fig 17 - Pattern Button

Pattern Selection Window

The Pattern Selection Window allows the user to select different groupings of the stimulus bars, creating different numbers of on-off pairs. Additionally, the user can modify the brightness of the pattern elements in different ways.

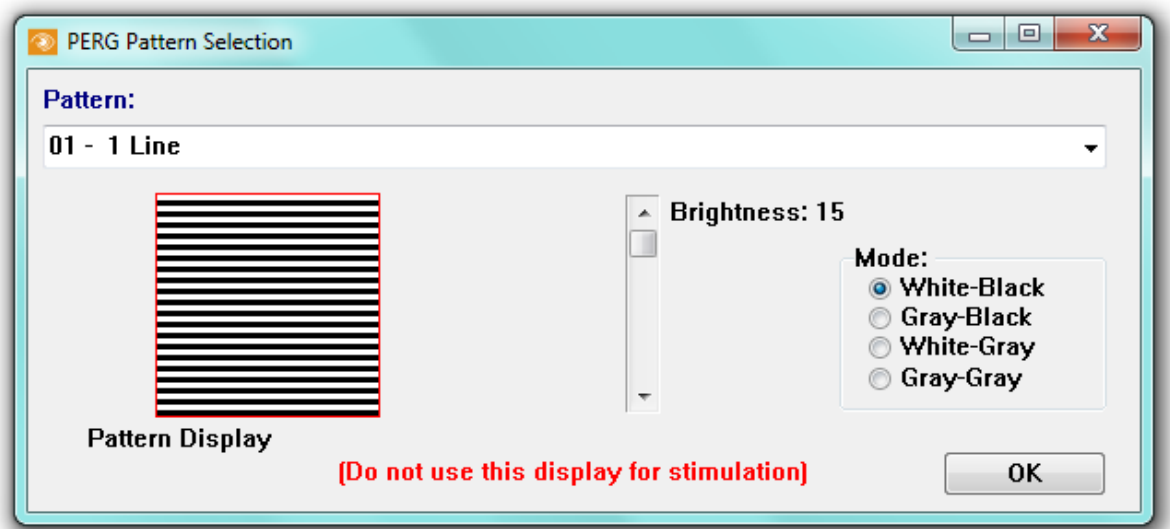


Fig 18 - Pattern Selection Window

The [Pattern Pulldown Menu] contains 8 different spatial patterns, ranging from a grouping of 40 bars (20 Black, 20 White) down to 2 bars (1 bBlack, 1 White). Additionally from this menu, the Luminance Control mode can be adjusted. There are 4 Luminance control modes that alter the way the Brightness slider affects the stimulus. The modes are as follows:

- **White-Black:** In this mode, the display will ignore the Brightness slider altogether. Regardless of the setting, in this mode the pattern will consist of white elements at maximum luminance and black elements at minimum luminance (maximum luminance, maximum contrast)
- **Gray-Black:** In this mode, the pattern will consist of black elements at the minimum luminance, and white elements of variable luminance (gray). Using the brightness slider (15 maximum luminance, 0 minimum luminance), the user can alter the overall mean luminance of the pattern stimulus, but the pattern will always remain at high contrast.
- **White-Gray:** In this mode the pattern will consist of white elements at the maximum luminance while the other cycle of the pattern will have variable luminance (gray). Using the brightness slider (15 max, 0 min) the user can modify the mean luminance AND contrast of the display.
- **Gray-Gray:** In this mode, the pattern will consist of two variable luminance intensities which will always exhibit the same mean luminance intensity. In this mode, the Brightness slider will vary the CONTRAST of the display without changing the overall mean luminance (Brightness zero -> 99% Contrast, Brightness 8 -> 0% Contrast). P

Please refer to the Contrast/Luminance reference sheet for the corresponding contrast and luminance values.

Selecting filters and gain

Filters determine which part of the incoming EEG signal is allowed to average into the response. Required filters will change based on the type of response that is being acquired. ABR responses, for example, are composed of higher frequency energy when compared to that of a LLR response. The frequency composition of responses may also vary with patient age or type of population. Having the right filters is important, or the important information may end up being filtered out of the average.

Gain determines how much the recording is amplified before averaging. The gain value should vary according to the type of response being acquired. An ECoG response, for example, is in the microvolt range and requires high amplification; where a P300 response is in the millivolt range and will require much less amplification. Having the correct amplification value will prevent the recording from either becoming undetectable from too low a setting, or from saturating the amplifier from too high a setting.

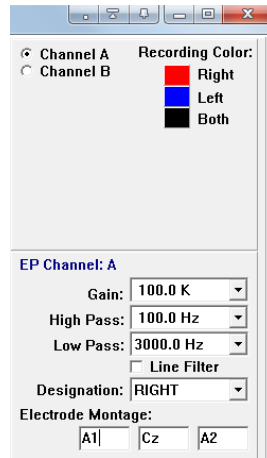


Fig. 19. - EEG and Amplifier Gain and Filter Settings

Setting hardware filters

For most cases, the correct filters and gain values will be set automatically when switching acquisition modalities. To modify the settings:

1. Open the EEG and Amplifier window by clicking on the **[EEG&Amplifier]** button from the SmartEP control panel.
2. The channel selection, filter setting, and gain settings are located on the right side of the window. Select the channel first using the radio buttons, then change the filter settings as needed; make sure to change the settings for all channels to be used during acquisition, as all channels have independent values. The filters in these settings are hardware based and have an attenuation value, see the USB Technical reference manual for actual attenuation values.
3. Click **[OK]** to commit the changes to the filters and gain.

The Line Filter (*notch filter*) check box should remain unchecked unless it is needed. This setting will activate an additional level of filtering to reduce the effects of excessive power line noise on the recordings. This filter is custom made for your location's line power frequency, be it 50 or 60 Hz.

Although the EEG and Amplifier window can remain open during acquisition, settings changes will not be applied until the **[OK]** button is clicked. Settings will not change if the software is in the middle of data acquisition, they will only apply to the next acquisition.

Automated digital filtering

Automatic digital filtering is possible for incoming recordings. However, using this feature is not recommended in most cases as recordings could end up being over-filtered, losing data definition. When this setting is active, incoming recordings will be filtered as they are acquired and any data loss due to the severity of the filters will be unrecoverable. A better option is to acquire without it, and then perform post-acquisition filtering, which is non-destructive since the original data has already been saved. If you still want to use this feature, activate it by choosing **[System > Filter]** from the main menu. The option is active when there is a check mark next to it (*will show the word ON in earlier versions*). To modify the digital filters, change their values under **[System > Digital Filter Settings]** in the main menu.

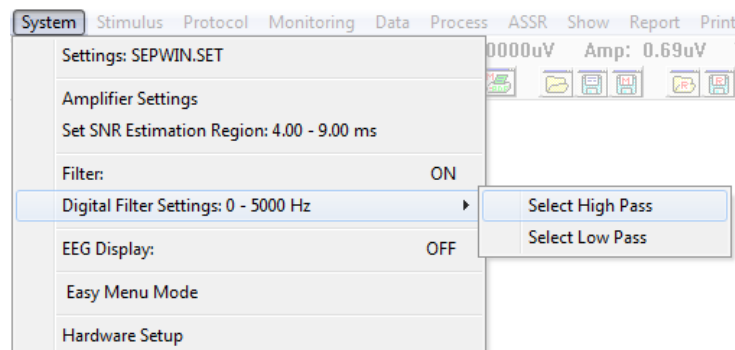


Fig. 20. - Digital Filter Options in the System Menu

Hardware filters vs. digital filters

- **Hardware filters:** This filter is based on physical components inside the hardware box. The filter has a slope, increasing its effectiveness for frequencies farther outside the filter limits. Influence from the frequencies outside the filters is still present, but greatly diminished.
- **Digital filters:** This filter is based on the Fourier Transform (FFT) of the signal performed in software. The filter is a full cutoff, where frequencies lower than the cutoff for high-pass, or higher than the cutoff for low-pass will be eliminated completely, no residual influence is left.

Artifact rejection

The rejection region and rejection level settings will determine what sweeps are allowed to be added into the average and which are rejected. It is better to reject sweeps containing muscular artifacts or other high level noise as they can harm an average and sometimes make it unusable. The settings can be found in the EEG and Amplifier window and are channel independent. To adjust them:

1. Open the EEG and Amplifier window by clicking the **[EEG & Amplifier]** button from the control panel.
2. Move the **[Level]** slider up or down to adjust the rejection level. This value is shown in percentage next to the slider, the actual microvolt value can be seen at the bottom right of the window labeled as **'Rejection'**. Moving the slider all the way up to 100% will cause all sweeps to be accepted, while moving it all the way down will cause everything to be rejected. A level of about 30% is usually sufficient for most acquisitions.
3. The rejection start and end time can also be adjusted by clicking on their respective adjustment buttons at the bottom of the live EEG graphic. This setting rarely needs to be modified since the applicable settings will be automatically loaded when changing acquisition modalities. In general, the rejection region should be set to cover the post stimulus region, accounting for any stimulus ringing that may occur; while trying to cover the entire region of the expected repeatable response.

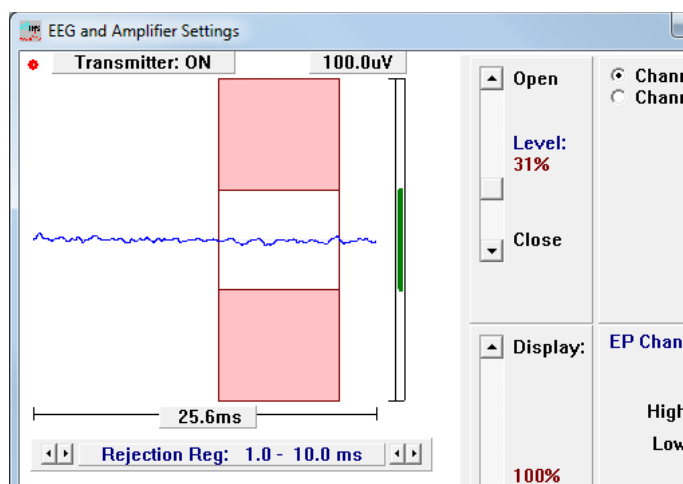


Fig. 21. - EEG and Amplifier window showing the rejection area.

4. Click **[OK]** to commit your changes.

As with the filters and gain settings, the **[OK]** button needs to be pressed for changes to take effect; closing the window with the **[X]** button will cancel any changes made to the settings. These parameters cannot be changed in the middle of a run and will only apply the next time the **[Acquire]** button is pressed.

Suggested acquisition parameters

The following shows suggested acquisition parameters for recording PERG responses in mice. These settings are starting points based on standard research test batteries. Consult the literature, then modify the parameters and electrode montage as needed to meet your acquisition goals. Adjust the settings accordingly for situations where there is excessive ambient noise, or when the patient has special needs.

PERG settings

- **Pattern Mode: White-Black**
- **Pattern: #4 (4 white elements/4 Black elements)**

- **Line Filter:** OFF. Only turn ON if there is excessive electrical line noise.
- **Gain:** 10k.
- **Low Pass Filter:** 100 Hz.
- **High Pass Filter:** 1 Hz.
- **Sweeps:** 372 (block size of 31).
- **Sampling Time:** 1 millisecond.
- **Electrode Montage:** Snout Paradigm.

Data Acquisition

7



Data acquisition

Starting acquisition

To start acquisition, simply click once on the **[Acquire]** button at the bottom left hand side of the control panel.

After pressing the button, it will change to read **[Stop/Pause]**.



Fig. 22. - Acquire button in the Control Panel

Pausing and stopping acquisition

When acquisition is started, the acquire button will change to a **[Stop/Pause]** button. Press the button to pause the acquisition. Although the acquisition process will be paused, stimulation will continue and the screen will refresh constantly even though sweeps are not being added to the average.

A confirmation screen will pop-up asking if you would like to continue with acquisition. Clicking on the **[Yes]** button will continue with the averaging, while clicking **[No]** will stop the acquisition process. After clicking **[No]**, you will be asked if you would like to keep the data or discard it.

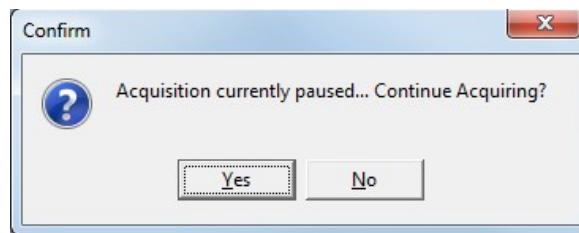


Fig. 23. - Stopping Confirmation

Assessing waveform repeatability

When acquiring a response, it is expected that the waveform will be repeatable, since this is the characteristic that qualifies the waveform as a true response to the stimulus. In most sessions, it is recommended to acquire at least two waveforms using the same parameters; when superimposed, waveforms will generally show a very similar structure.

Note that no two waveforms will be exactly the same and there is a small variability factor expected between one acquisition and the next including small variations in amplitudes and in peak latencies. This variability is mainly a factor of noise, the noisier the recording conditions, the more variable the response will be. Eventually, if enough sweeps are acquired, all averages would look almost exactly the same; however, this is highly impractical due to time considerations.

In cases where acquiring a second waveform is not feasible, it is still possible to assess repeatability by showing the waveform in split buffer format. When viewed as a split buffer, the waveform will show two tracings, one for the average of the odd numbered sweeps and one for the average of the even numbered sweeps. There are two ways to do this:

- Right click on the waveform in question, then from the context menu choose **[Plot Type > Split Sweep]**. To return to the normal view choose **[Plot Type > Average]**
- Open the Recording Information panel by pressing the **[Rec Info]** button on the right side of the screen, change to the display tab, then choose the **[Split Sweep]** radio button from the list. To return to the previous view, simply choose the **[Average]** radio button.



Placing labels

Labels are very important tools as they will help you determine the latencies and amplitudes of the expected response. Each label consists of two markers, a top arrow pointing down, and a bottom triangle pointing up. The top marker helps determine the latency at which a peak or valley occurs, where the bottom marker helps determine the amplitude of the waveform by calculating the difference in voltage between the top and bottom marker. Placed labels are saved to the recording automatically, there is no need to save a waveform manually after placing labels on it.

Marker labels can be placed on a recording in two ways:

- Using the marker buttons on the tool bar. First select the recording that you wish to label, the markers shown may update to reflect the selected recording type. Click on the label button (*on the tool bar*) once, then click just above or below the location where you want the label's top marker to be placed. Once the label is in place, left-click-hold and drag the bottom marker to it's proper location.
- With the recording selected, right click on the location where you want the label's top marker to be placed. From the context menu, select either **[Mark Peak]** and the standard label you wish to place, or **[Mark Other Peak]** to select from non-standard labels. Once the label is in place, left-click-hold and drag the bottom marker to it's proper location.

When printing marked recordings, applicable labels to the type of recording will be listed on a table at the bottom half of the printed page. If the table information for a specific recording is not showing, the recording may have been acquired using the wrong modality, to correct this simply re-save the recording using the **[Data > Save File As]** option from the main menu.

PERG markers

There are three markers used for identifying PERG recordings.

- **N1**
- **P1**
- **N2**

Typically, the most important component to report is the P1 component, the latency of which is typically around 100ms and the amplitude is measured from the P1 peak to the N2 trough.

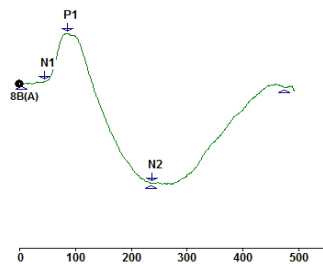


Fig. 24. - PERG recording (from Mouse)

User defined labels

Users can define specific labels to be used to mark their recordings. User Defined labels are saved with the file as soon as they are placed, so even if they are moved and loaded into a different computer, the label will remain.

Creating a label

1. Right click on a recording to open the Peak Labels window.
2. In the **'User Defined Labels'** field, enter the text for your label.
3. Click on the **[Add to List]** button.
4. Click on the **[Save List]** button.

The label list can also be modified directly by editing a text file. This should only be done by users who are familiar with the Windows operating system. The list can be found in the **'Settings_EP'** folder in the **"UserPeakLabels.Txt"** file. This file can be edited directly by entering one label name per line using any text editor, like Windows Notepad. Note that a custom label may be placed without saving the list first, this will place and save the label on the recording, but the label will not be available from the list in the future.

Placing a user label

1. With the recording selected, right click over the position where you want the label placed.
2. From the context menu, select **[Mark Other Peak]**.
3. Choose the label you want to place from the list of **'User Labels'**.
4. Click on the **[Mark Peak]** button.

Post-acquisition filtering

Once a recording has been acquired it can be filtered with either a smoothing filter, or spectral filters as needed. Filtering post acquisition is a non-destructive process since the original data will be preserved in the original recorded file. When filtering the waveform is copied to a new buffer, leaving the previous one intact. Note that if you want to keep this filtered version, you will need to save the recording manually, or save a report.

Smoothing filter

The smoothing filter used in software is a Finite Response Filter. Settings allow for smoothing from very mild (*7 point smoothing*) to very strong smoothing (*25 point smoothing*). To smooth a recording:

1. Click on **[Process > Filter Type]** from the SmartEP main menu.
2. In the window that opens, select the **[Filter Type]** as **'FIR'**, and adjust the slider to the left for less filtering, or to the right for more filtering.
3. Click **[OK]** button to close and confirm your selection.
4. When filtering only one response, select the recording to filter, then click on **[Process > Filter Active]** from the main menu. When filtering all the recordings in the current page, click on **[Process > Filter ALL Displayed]** instead.

Spectral filter

The digital spectral filters in software have two possible options. The Band Pass filter keeps frequencies from the high pass value to the low pass value, frequencies falling above the low pass or below the high pass will be filtered out. Band Pass filtering is typically used to filter out strong high frequency or low frequency noise, where the noise falls outside the selected filter settings.

Smart Tip:

When an existing recording is filtered, a new filtered copy of the recording is created. The original recording is always available from the data list.

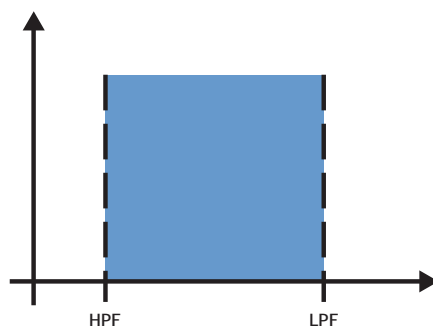


Fig. 25. - Digital band pass filter, frequencies not contained in the range are filtered out.

The Notch option filters out the frequencies in between the selected low pass and the high pass filters, leaving intact those that fall outside the range. The Notch option can be used when the line noise was too high and shows up in the response, filtering out the power line frequency (50 or 60 Hz, depending on location) while leaving the rest of the response untouched.

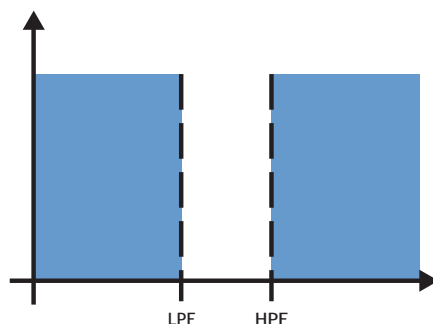


Fig. 26. - Digital notched filter, frequencies inside the range are filtered out.

To filter a recording using a digital spectral filter:

1. Click on [\[Process > Filter Type\]](#) from the main menu.
2. In the window that opens, choose whether you want to use a **'Band Pass filter'** or a **'Notch filter'**.
3. Enter values for the low and high pass filters.
4. Click **[OK]** button to close and confirm your filter selection.
5. When filtering only one response, select the recording to filter, then click on [\[Process > Filter Active\]](#) from the main menu. When filtering all in the page, click on [\[Process > Filter ALL Displayed\]](#) instead.

Adding waveforms

Two or more waveforms can be added up to create a new grand average. There are two methods of addition **'Sweep Weighted'** and **'Microvolt Weighted'**. A sweep weighted addition will take in consideration the number of sweeps that each added recording contains, creating a grand average; In this case, adding two similar acquired recordings with 1000 sweeps each would be the equivalent of just acquiring a single one with 2000 sweeps. A Microvolt Weighted addition will ignore sweep counts and treat each recording as if they were one sweep each. To choose which method to use, select the option by clicking on the [\[Process > Addition/Subtraction Mode\]](#) option from the main menu. To add two waveforms:

1. Select the addition mode from the main menu.
2. Activate one recording by clicking on it, or it's handle. The handle of the currently selected recording will turn to a black filled circle, and the waveform will change color to green.
3. Activate the other recordings to be added by clicking on them while holding the **[Ctrl]** key on the keyboard. Any other recordings selected will have a grey handle.
4. Select [\[Process > Add Selected\]](#) to add them, or press on the **[+]** key on the keyboard. A new recording buffer will appear with the resulting waveform.

If there are many recordings that need to be acquired it may be easier to load them all to a single page and then use the [\[Process > Add all on Page\]](#) menu item.

Additional operations

Subtraction

Two recordings can be subtracted in an operation resulting in Buffer A minus Buffer B, Where A is the selected recording (*in green with the black handle*), and B is the secondary recording (*standard recording color and gray handle*):

1. Select operand B from the recordings on your screen by simply clicking on it, or it's handle.
2. Hold down the **[Ctrl]** key on your keyboard and select operand A by clicking on it, or it's handle.
3. From the main menu, choose **[Process > Subtract Selected]**, or press the **[-]** key on your keyboard.
4. A new buffer will appear with the resulting operation. Make sure to save it if needed.

Multiplication

Recording amplitudes values are multiplied by the entered value.

1. Select the recording to multiply by clicking on it, or it's handle.
2. From the main menu, choose **[Process > Multiply (Active)]**.
3. Enter a multiplication constant value, then click **[OK]** to confirm.
4. The buffer will be shown with the multiplication factor applied. To save the modified recording, while keeping your original data click on **[Data > Save As]** and choose the appropriate option. Clicking on **[Data > Save]** will overwrite the existing recording.

Smart Tip:

If you accidentally swapped the non-inverting and inverting electrodes, simply use the inversion feature to set the waveform right-side up.

Inversion

Sometimes it may be necessary to invert a recording, simply because the electrodes were accidentally reversed, or maybe a subtraction operation was performed while selecting the recordings in the wrong order.

1. Select the recording to invert by clicking on it, or it's handle.
2. From the main menu, choose **[Process > Invert (Active)]**.
3. To save the recording with this new polarity, click on **[Process > Save]**.

Time-shifting

Recordings can be shifted in time to account for unforeseen delays, to account for stimulus delays, or to align one recording with another.

1. Select the recording to time-shift by clicking on it, or it's handle.
2. From the main menu, choose **[Process > Time Shift Data (Active)]**.
3. Enter the time-shift value in milliseconds. Use positive numbers to shift data to the right, and negative numbers to shift data to the left.
4. The time-shifted recording will be placed in a new data buffer. To save this data, click on **[Data > Save]** from the main menu.

Splitting the buffers

Each recording buffer contains two internal average buffers. When data is acquired, the even numbered recordings get averaged in one buffer, while the odd numbered ones get averaged into the other.

Select the recording by clicking on it, or it's handle.

1. From the main menu, choose **[Process > Split Buffers (Active)]**.
2. The two average buffers will be split into two new recording buffers. To save these, click on **[Data > Save]** from the main menu.

Smart Tip:

Split buffers can also be used as a measure of waveform repeatability, this is specially useful for situations when acquiring additional waveforms is not possible.

Cross-correlating two recordings

This function will help determine how similar two recordings are. For the purpose of this calculation, an area of comparison needs to be pre-defined, the cross correlation value will be calculated for the portions of the recordings falling within this area. The resulting number is a fractional number where 1 is perfect correlation, the larger the difference between the two recordings, the lower the value will be.

Turn on Cursors to be able to define the cross correlation area. Click on **[Show > Show Cursors]** to turn them ON. When ON, the option has a check mark to the left of Move the cursors to the start and end points of your cross-correlation region. Cursors can be moved by dragging on the handle and the bottom of each cursor. When turned ON, cursor handles can be found at the bottom left of the recording area, just above the time scale.

1. Select the two recordings while holding the **[Ctrl]** key.
2. From the main menu, click on **[Process > Cross Correlate (Selected)]**.

Self cross-correlation

Since each recording buffer contains two internal averaging buffers, these can be compared to each other to judge the repeatability of the waveform.

1. Turn ON Cursors to be able to define the cross correlation area. Click on **[Show > Show Cursors]** to turn them ON. When ON, the option has a check mark to the left of it.
2. Move the cursors to the start and end points of your cross-correlation region. Cursors can be moved by dragging on the handle and the bottom of each cursor. When turned ON, cursor handles can be found at the bottom left of the recording area, just above the time scale.
3. Select the recording by clicking on it, or it's handle.
4. From the main menu, click on **[Process > Cross Correlate - Split Sweep (Active)]**.

Note: to graphically view the contents of both buffers (*on a single recording*), right click on the recording and select **[Plot Type > Split Sweep]**, to return it to normal view select **[Plot type > Average]**.

Cross-correlating to all others on page

1. Turn ON Cursors to be able to define the cross correlation area. Click on **[Show > Show Cursors]** to turn them ON. When ON, the option has a check mark to the left of it.
2. Move the cursors to the start and end points of your cross-correlation region. Cursors can be moved by dragging on the handle and the bottom of each cursor. When turned ON, cursor handles can be found at the bottom left of the recording area, just above the time scale.
3. Select the recording by clicking on it, or it's handle.
4. From the main menu, click on **[Process > Cross Correlate (Selected) with All on Page]**.
5. A Notepad file will open with the cross-correlation values when the selected recording is compared to all the ones currently in the page.

Comparing recordings from oppositesides.

In some instances it is necessary to compare a recording acquired from the left channel, to one acquired from the right channels. Before doing this, make sure the recordings you want to compare have been acquired using the exact same parameters or the comparison will not work. The resulting comparison data will depend on the type of data being compared.

1. Mark all necessary labels on the recordings being compared.
2. Select both waveforms by holding the **[Ctrl]** key and clicking on them, or their handles.
3. From the main menu, select **[Process > Compare (Selected)]**.

4. If all the comparison parameters are valid, then a pop-up window will show the results of the comparison. These results can be placed on the page as well.

Comparison information can also be obtained by opening the recording info panel and selecting the two recordings. The comparison information will be displayed in the **'Comp'** tab. It can also be added to the page directly from there.

Waveform power spectrum

Some advanced users, mainly researchers, may want to look at the frequency components of the waveforms recorded. There are multiple ways to see this information.

Displaying a recording in spectral mode

To see the recording directly in spectral mode, right click on it to open the context menu, then select [\[Plot Type > Spectral\]](#). The recording will now be shown as two graphs. The color waveform (*green if selected*) shows the spectral plot of the average from both internal buffers ($A+B$), while the black waveform shows the spectral plot of the difference between the buffers ($A-B$). Notice that while this recording is selected, the **'Time'** display in the indicator line will change from showing time position to showing frequency position.

Viewing a detailed spectral graph

To view a more detailed power spectrum of the recording, select the recording, then click on **[Process > Power Spectrum]** from the main menu. The Spectrum Analysis window will open showing the full recording including the pre-stimulus area on the left, and the power spectrum of the recording on the right. The post-stimulus region is shown in **Blue**, while the pre-stimulus region is shown in **Red**. It is possible to adjust the spectral graph using the sliders at the bottom right corner of the window. The graph can also be shown as a dB plot, the current graph can be printed, or it can be saved to an ASCII file and imported into a third party program. When using the Advanced Auditory module and generating multiple consecutive data buffers, they can all be added up by selecting them all and then using the **[Process > Advanced Module Multi Buffer Power Spectrum]** option from the main menu.

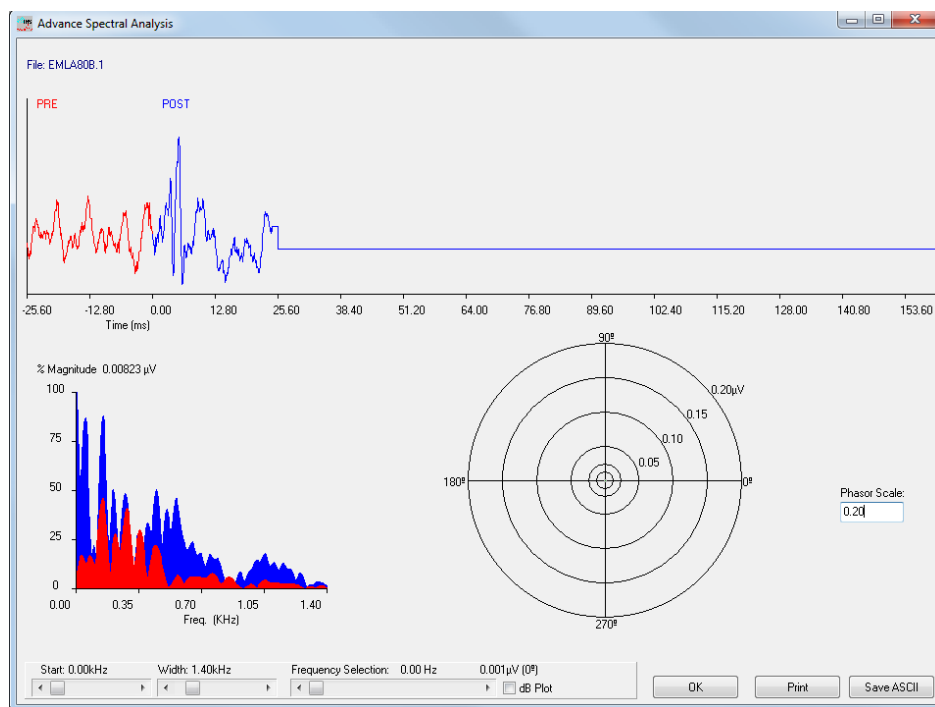


Fig. 27. - Spectral Analysis window showing an ABR recording

Managing Recordings

9



Saving and renaming files

In the PERG software, the Auto-Save feature is turned ON by default, and recordings are saved automatically as they are acquired. The only two reasons why a recording will need to be re-saved are: the setting was turned OFF manually, or some post-acquisition processing has taken place where the data was placed in a new recording buffer. Unsaved files will show the name as **'NEW'** in the indicator bar.

Saving an Individual file

These two steps will save one single recording, assigning a file name automatically based on the standard naming convention.

1. Select the recording you wish to save by clicking on it, or its handle.
2. From the main menu click on [\[Data > Save File\]](#).

Saving all displayed files

This will save all the file currently on the screen. Recordings that are labeled as **'NEW'** will have file names automatically assigned based on the standard naming convention. To do this, simply click on [\[Data > Save All Files\]](#) from the main menu. This can also be accomplished by saving all current data in a report using [\[Report > Save Report\]](#).

Saving as a different data type

If a recording was acquired under the wrong modality, it may be assigned an incorrect data type. This situation may prevent proper labeling and the automatic calculation of some ratios. To recognize a recording acquired under the wrong modality, look at the fourth letter in the recording name, which indicates modality and refer to the **"Naming convention"** section that follows. To correct this issue:

1. Select the recording with the incorrect data type by clicking on it, or its handle.
2. From the main menu, click on [\[Data > Save File As...\]](#) and choose the correct data type from the submenu.
3. The recording name will change to reflect the new data type.

Smart Tip:

Recordings acquired under the wrong data type, or saved with the wrong file name, will prevent the software from calculating ratios and latency differences. Make sure to use the software naming convention to prevent this.

Custom file names

It is possible to fully customize the name of a recording using the [\[Data > Save File As > Specific File Name\]](#) option in the main menu. Any name could be used, however it is better to adhere to the naming convention so that the software can properly recognize the data type, and perform any required automatic calculations.

Naming convention

File names are of the following format: **'xxSMiiC.nn'**. Where:

- **xx**: Patient's initials. I.e. all recordings for patient John Doe will have a name that starts with JD.
- **S**: Side of stimulation. R for right, L for left, B for both.
- **M**: Testing modality. **E** for ECoG, **A** for ABR, **M** for MLR, **L** for LLR, **P** for P300, **V** for Visual, **R** for P50, and **T** for Somatosensory.
- **ii**: Intensity value. This indicates the intensity value that was used, be it SPL or HL.
- **C**: Hardware acquisition channel.
- **nn**: Recording Number. Numbers are used incrementally when more than one recording share the same settings as specified in the rest of the file name.

Loading files

To load previously acquired recordings, individually or in groups:

1. Make sure you have the correct patient file loaded.
2. Click on [\[Data > Load File\]](#) from the main menu.

3. If you are searching for a specific recording type, select it from **[Recording Type]** check boxes and deselect the ones you do not need. This should help you narrow the list in patients where many different tests have been run.
4. Use the sorting options if needed by clicking on the **[Sort Order]** radio buttons.
5. Select the recording you wish to load by clicking on it on the list, the selected recording will have a blue background. To select consecutive recordings, hold the **[Shift]** key on your keyboard while clicking on the first and the last recordings you want to load. To choose more than one recording, not shown consecutively, hold down on the **[Ctrl]** key while clicking on the items from the list.
6. If you want to pre-select how the recordings are arranged on the page when loaded, click on the desired option at the bottom right of the window. Choose between **'Intensity'**, **'Acquisition Order'**, **'Stimulation Rate'**, or **'None.'**
7. Click **[OK]** to load.

Moving recordings

When acquiring multiple consecutive sets of data, it is recommended to separate the data using the 10 possible display pages. This can be used to separate data when performing a threshold search at multiple frequencies, where the data from each stimulus frequency will be separated by page. It is also useful when running multiple protocols such as ECochG, ABR, and P300 on the same patient. Some of this can be accomplished automatically as described in **"Organizing recordings automatically"** on page 44. To manually move recordings do one of the following:

- A single recording can be moved by:
 - Selecting the recording, right-clicking on it, then choosing one of the options in the **[Send to Page]** submenu.
 - Selecting the recording, then dragging it using the mouse (*holding the left mouse button and moving it*) to one of the page buttons on the right hand side of the screen. This method can also be used to separate data on a split-page mode between the right and left sides of the page.
- Multiple recordings can be moved by:
 - From the **[Set Page]** buttons select one of the options under **[Send All Data on this page to]**. Keep in mind that this option will move all data on the page to the chosen destination.
 - Hold the **[Ctrl]** key and select multiple recordings; then while still holding the **[Ctrl]** key, hold the left mouse button and drag them to the page number on the right hand side of the screen.

Organizing recordings automatically

The software can arrange the recordings automatically as they are acquired, when loaded, or after acquisition is completed. The recordings can be automatically arranged by intensity, by acquisition rate, or by acquisition order.

- **While Acquiring:** in the main menu, choose the desired arrange method from the options given under **[Show > Acquisition Auto-Arrange by]**. Recordings will be organized according to the specified setting as soon as they are finished acquiring.
- **While Loading:** in the Load Data window, select one of the arrange options from the panel at the bottom right of the window.
- **After Acquisition:** Select one of the show options from the **[Show]** menu. Available options include **"by Intensity"**, **"by Rate"**, and **"by Acquisition Order"**. Equivalent arrange options can be found in the tool bar, marked as **"I"**, **"R"**, and **"O"** respectively.

Changing the page display settings

Generally, data is shown on the screen in a normalized vertical scale with a horizontal time scale corresponding to the type of testing being performed. In certain cases it may be necessary to change these settings to better accommodate the data, or simply to make it easier to understand. All options for changing the way data is shown can be found in the side menu, which can be opened by clicking on the **[Set Page]** button. None of these options make any changes to the actual acquired data, just to the way it is shown.

Scale and Scaling

Scale refers to the vertical unit of measurement used for showing the recordings. Usually the scale is set to normalized page mode by default. The following modes are available:

- **Normalized:** The software looks at each individual recording, detecting its maximum and minimum values and **"zooming"** in on it, making it fit on the allotted space (defined by the **'Plot Size'** setting in the **[Set Page]** menu). This setting is useful when looking for thresholds to low intensity stimuli; however, the expected decrease in amplitude based on response to the stimulus level will not be observed.

- **Normalized Page:** The software looks for the recording with the largest Peak-to-Peak amplitude and sets the vertical scale based on that recording; all others on the page will be also set to that vertical scale. This setting is useful to observe the decrease in response amplitude as stimulus level decreases. This is the recommended setting for report generation.

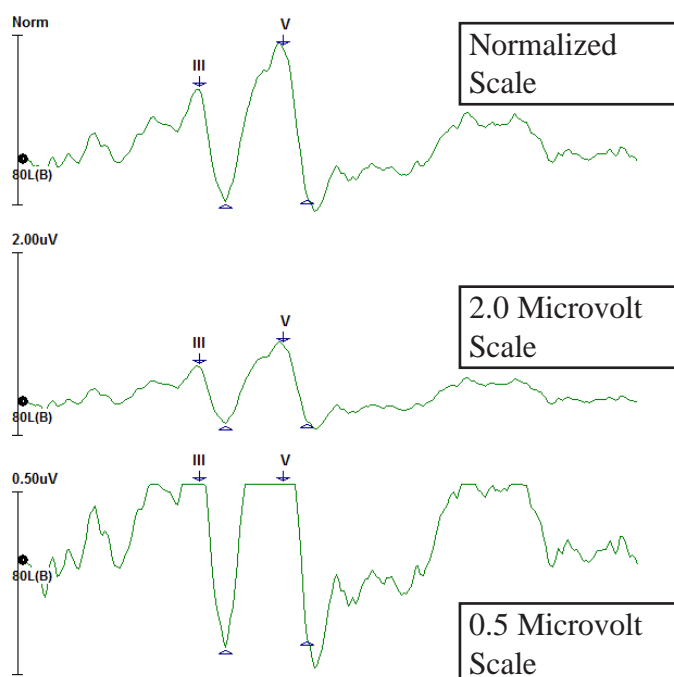


Fig. 28. - Same recording shown in different scales.

- **Microvolt Values:** A user can set a specific vertical scale value by choosing one of the pre-set values or entering a custom one. This setting is recommended when there is a need for consistency from one report to the next, or when trying to provide additional zoom to a particular area of interest. Keep in mind that setting too small a value, one that exceeds the peak-to-peak amplitude of the recordings on the page, will lead to clipping as seen on Fig. 39.

Creating advanced reports

Most users will only organize recordings, mark the corresponding peaks, and then print a results sheet. Advanced users may want to create more complete reports including additional text and comment fields, tables with data across pages, or data acquired in other IHS programs. The following items can be added to any report page.

- Single lines of text can be added using the [\[Report > Add Label\]](#) menu option.
- Paragraphs, or text fields with multiple lines can be added using the [\[Report > Add Text\]](#). the text field can be pre-filled with demographics information by choosing the **'Demographics Information'** option from the menu.
- Patient information can be added using the [\[Report > Add Demographic Information\]](#) menu option. This information is static, so it will not change if the patient information is changed in the patient demographics window.
- Recording Information can be added as a text field. Choose [\[Report > Add text \(Active\) Recording Information\]](#) option. Choose **'static'** if you want to edit the information manually, or **'dynamic'** if you want the information to update automatically if any changes on the recording occur, such as a new peak label. Dynamic tables can be added to the page, then moved to a different page while still keeping the link to the data on the original page.
- All static text fields, including demographics information, data tables, and recording information can be edited manually by right clicking on the report item while it's selected and choosing the [\[Edit\]](#) option from the context menu.

Smart Tip:

Keep the top-left area of the screen clear when adding new report items. Since that is the default item placement, keeping that area clear will make it easier to reposition the items after.

Saving and loading reports

Once all data is acquired, and any additional report items are created and organized, the report can be saved to a file using one of the following options:

- Click on **[Report > Save Report]** from the main menu.
- Click on **[Data > Save Report]** from the main menu.
- Click on the **[Save Report]** button on the tool bar.

The saved report file is simply a collection of pointers to the individual file and report items on the page. Keep in mind that permanently deleting, or moving, a data recording, or a report item, from the drive will make it impossible for a report to load that recording, and will prompt with an error indicating that the data is not found. If this happens, re-save the report so that it will not give an error next time it is loaded.

To load a previously saved report, use one of the following options:

- Click on **[Report > Load Report]** from the main menu.
- Click on **[Data > Load Report]** from the main menu.
- Click on the **[Load Report]** button on the tool bar.

Reports can also be saved to a PDF file, keeping an electronic copy of it.

Data export tools

Exporting one or more recordings to ASCII

The point-by-point information contained in the recording can be exported to a text file, also known as ASCII files. These type of files can be easily imported into spreadsheet application or many other applications. To export a single recording, select it by clicking on it, then select **[Data > Save As ASCII...]** from the main menu. The ASCII file contains the following information:

- Recording information including:
 - Patient identifier (*see "Subject File Management" on page 15 for more information*).
 - Recording file name (*see "Naming convention" on page 41 for naming details*).
 - Side of stimulation, Marked as Left (*L*), Right (*R*), or Both (*B*).
 - Channels used for acquisition, 1 for channel A, 2 for channel B, etc.
 - Stimulation rate in presentations per second.
 - Stimulus mode, There are 4 internally-defined channels of sound output, shown here in binary ON (*1*)/OFF (*0*) coded as **'(R1)(R2)(R3)(R4)'**. A code of **'1'** means only the first right channel was used, A code of **'101'** means that the first right channel and the first left were used.
 - Number of averaged sweeps.
 - Number of artifacts.
 - Sampling period, length of time between samples.
 - Amplifier gain.
 - Low pass filter.
 - High pass filter.
 - Notch filter status as TRUE when it's ON or FALSE when it's OFF.
 - Stimulus type code, **'1'** for clicks, **'100'** for tones, or the actual file name when using a pre-defined stimulus file.
 - Stimulus frequency, if using tones.
 - Stimulus duration in milliseconds.
 - Masking level in dB SPL.
 - Zero time position in points (*time of stimulation*).
- Table of peak information including:
 - Label: label name.
 - Peak (+): top peak marker data point position.
 - Peak (+) (*ms*): top peak marker equivalent time position.
 - Peak (-): bottom peak marker data point position.
 - Peak (-) (*ms*): bottom peak marker equivalent time position.
- Data point information table including:
 - Data Pnt: Data point number. Each recording will have 1024.
 - Data Pnt (*ms*): Data point time position in milliseconds.

- Average: 16 bit A/D value. If multiple data files are being exported, there will be one column per data file.
- Average: average amplitude value converted to microvolts. If multiple data files are being exported, there will be one column per data file.
- Buffer1 and Buffer2: 16 bit A/D values for each internal buffer. This information is only included when exporting a single data file.
- Buffer1 (μV) and Buffer2 (μV): buffer amplitude values converted to microvolts. This information is only included when exporting a single data file.

Exporting the FFT to ASCII

The FFT of a recording can be exported using the options in the Power Spectrum window. The resulting text file will contain most of the same information as the exporting of Time data except for the microvolt values for each of the buffers and the average. Instead, it will include the following fields:

- **Frequency:** The frequency of the plot point.
- **Pre-Spectra (pV^2):** Value of power at the frequency for the pre-stimulus region.
- **Pre-Spectra(dB):** Value of power at the frequency in decibels for the pre-stimulus region.
- **Pre-Phase(Deg.):** Phase of the response at that frequency for the pre-stimulus region.
- **Post-Spectra (pV^2):** Value of power at the frequency for the post-stimulus region.
- **Post-Spectra(dB):** Value of power at the frequency in decibels for the post-stimulus region.
- **Post-Phase(Deg.):** Phase of the response at that frequency for the post-stimulus region.

Printing

Printing records

The contents of the report pages can be printed to the default windows printer using one of the following options:

- Use the **[Print > Print Page]** menu item to print the report page currently displayed.
- Use the **[Print > Print ALL Pages]** menu item to print all report pages containing information. Blank report pages will not print when using this option.
- Click on the respective **[Print]** buttons, **[Print Page]** or **[Print All Pages]**, from the tool bar to print a single page or all report pages.

Printing to electronic file (PDF)

The software can generate an electronic copy of the report without the need for a printer. To create the PDF format file:

- Use the **[Print > Print Page PDF preview]** menu item to print the report page currently displayed.
- Use the **[Print > Print All Pages PDF Preview]** menu item to print all report pages containing information. Blank report pages will not print when using this option.
- Click on the respective **[Print]** buttons from the tool bar to print a single page or all report pages.

Smart Tip:

The software can generate a PDF report without the need for PDF printer software installed on the PC. However, at least a PDF reader is needed to view the files. PDF reader software is freely available on the internet.



Menu and Function Reference

Main Screen Buttons and Menu

Control Panel

These are the buttons commonly found in the Control Panel in the PERG modality. In other modalities the buttons will either have different units, be replaced, or disabled.

- **[SIDE]:** Determines the transducer to be used for stimulus; right, left or both. Single left or right clicks will cycle through the options.
- **[Mode]:** Determines the designated acquisition side. It can be set to Ipsilateral, Contralateral, or Both. Single left or right clicks will cycle through the options. **(For PERG keep on Ipsi)**
- **[Pattern]:** Opens the Pattern Selection Window
- **[Mod]:** Shows the current modality.
- **[Sweeps]:** The **[Sweeps]** button is followed by 4 numbers. These numbers correspond to the following fields:
 - **[Baseline Sweeps]:** Number of sweeps to present an isoluminant grey stimulus field prior to the normal acquisition.
 - **[Onset Sweeps to Reject]:** Sweeps to reject immediately after stimulus onset.
 - **[Sweep Block Size]:** Sub-block sweep size. The software will save sub-block averages of main recording of the designated size. In the modes of the Experiment tab, the block size will dictate how many sweeps will be obtained at each contrast/spatial frequency value.
 - **[Total Sweeps to Acquire]:** Number of sweeps to acquire for the total acquisition.
- **[Rate]:** Determines the rate of presentation and acquisition. It is given in number of repetitions per second. Single left clicks will decrease the amount by 10, single right clicks will increase the amount by 10, and double clicking will open a window so a specific value can be entered.
- **[Time]:** Determines the sampling time for the individual points of a recording. It also shows in parenthesis the post-stimulus recording time. Single left clicks will half the time, single right clicks will double the time, and double clicking will open a window so a specific value can be entered. This value can only be entered in 25 µs increments.
- **[EEG & Amplifier]:** Opens the EEG and Amplifier window.
- **[Acquire]:** Starts acquisition based on the selected parameters. The button will change to **[Stop/Pause]** when pressed.
- **[Stop/Pause]:** Pauses the acquisition and opens a window asking if it should stop or continue. The button will change back to **[Acquire]** when acquisition is fully stopped.
- **[Continue]:** Averages additional sweeps into an existing recording.
- **[Restart]:** This button replaces the **[Continue]** button during acquisition. When pressed, the recording will start over.
- **[Clear Page]:** Clears all recordings from the page. Any recordings not previously saved will be lost; all others can be retrieved using the options in the data or report menus.
- **[Load Settings]:** Opens a window to load an existing settings file from the **"Settings_PERG"** folder.
- **[Save Settings]:** Allows the user to save all current settings to a file in the **"Settings_PERG"** folder.

Mod: PERG	Side: Right	Mode: Ipsi	Pattern: 1 (G-B) Brightness: 15	EEG & Amplifier
Acquire	Sweeps: 50 / 5 / 50 / 600	Rate: 2.02/s	Time: 1.0ms (512.0)	Save Settings
	Continue	Clear Page	Load Settings	

Fig. 29. - Control Panel for PERG mode

Quick Access Tool Bar

The quick access tool bar is located right under the main menu. It contains shortcuts to some of the most commonly used menu items. The following is a list of buttons that appear on this tool bar, from left to right.

- **[New Patient]:** Equivalent to the **[New]** option from the Patient menu.
- **[Load Patient]:** Equivalent to the **[Load]** option from the Patient menu.
- Peak label marker buttons change depending on type of recording selected, shown on the following figure are

Set Page menu

The Set Page menu is located on the right side of the main window, it can be opened using the button of the same name. It contains options for modifying the way recordings are displayed; none of them will modify the data, only the way it is shown. Settings for each page are independent; however they can be copied to all pages.

- **Page:** Indicates the current page being displayed.
- **Scale:** Defines whether the recordings are scaled to a defined microvolt value, normalized, or normalized to the page. Normalized scales the recordings individually by expanding their vertical scale to fit their allowed Plot Size. Normalized-Page finds the recording with the largest peak-to-peak value and scales the entire page to that value.
- **Scaling:** When recordings are shown in normalized mode, scaling defines if the normalization is done over the entire display window (between plot start and plot end) or only within a defined time (between scaling start and scaling end).
- **Scaling Start:** Defines where normalization should start when recordings are shown normalized and scaling is set to Special. The options will be inactive if the scale is set to a microvolt value, or scaling is set to Display Window.
- **Scaling End:** Defines where normalization should end when recordings are shown normalized and scaling is set to Special. The options will be inactive if the scale is set to a microvolt value, or scaling is set to Display Window.
- **Page Mode:** Allows the switching between Full page mode and Split page mode. In Split page mode, the screen is divided into two, usually showing left-ear recordings on the left and right-ear recordings on the right.
- **Move Mode:** Sets the way recordings can be moved and placed on the page. When set to Free, recordings can be placed at any position vertically, they will still snap to the left side to match the time scale. When set to Fixed, the recordings will snap to predetermined vertical positions. The number of available positions varies based on the Plot Size setting.
- **Plot Size:** Defines how much vertical space a recording can occupy. Note that if set at higher values, recordings will start stacking on each other since vertical space is shared. At 100%, all the recordings will overlap and take the whole screen, specially if normalized.
- **Plot Start Time:** This option defines the start of the horizontal time scale at the bottom of the page. It is only available while in Full Page mode.
- **Plot End Time:** This option defines the end of the horizontal time scale at the bottom of the page. It is only available in Full Page mode.
- **Plot Time:** When active, the start and end time of the display will apply the same settings to both the left and the right. This option is only available on Split Page mode.
- **Grid:** Toggles the display of vertical grid lines across the display area. A total of eleven grid lines per time scale are displayed.
- **Apply above to:** Applies all the settings as selected on this page, to the selected display page. Check the organization of those pages after this operation as some data may have shifted.
- **Clear all data on this page:** Removes all data and report items from the page. It does not delete items from the hard drive.
- **Send all data on this page to:** Sends all data and report items to the page selected from the sub-menu.
- **Close:** Closes the menu.

Page: Acq.	
Scale: 0.75	▶
Scaling: Display Window	▶
Scaling Start: 0.00 msec	
Scaling End: 12.80 msec	
Page Mode: Split ▶	
Move Mode: Free	▶
Plot Size: 14.3%	▶
Left - Plot Start Time: 0.00	
Left - Plot End Time: 12.80	
<input checked="" type="checkbox"/> Plot Time: Right = Left	
Right - Plot Start Time: 0.00	
Right - Plot End Time: 12.80	
Grid: OFF	▶
Apply above to: ▶	
Clear data on this page	
Send all data on this page to	▶
Close	

Recording context menu

The recording menu appears when right-clicking over the active recording. It contains the following options and information:

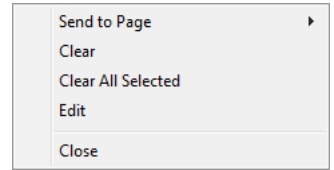
- **Recording File Name:** Moving the mouse over this menu item will open a fly-out menu showing information about the recording.
- **Peak Latency:** Moving the mouse over this menu item will open a fly-out menu showing information about the marked peak labels including latencies, amplitudes, and inter-peak latencies. Other calculations such as ratios may also show here if applicable.
- **Mark Peak:** Shows a sub-menu with peak labels applicable to the active recording. When selecting one of the options, the label will be placed at the time position where the mouse pointer was at the time the menu was opened. Drag the label to the appropriate location after placement.
- **Mark Other Peak:** Opens the Peak Marking window, showing all possible standard labels, and allowing for custom labels. The label will be placed at the time position where the mouse pointer was at the time the menu was opened. Drag the label to the appropriate location after placement.
- **Remove Peak:** The *“Specific Peak”* option clears the label closest to the time position of the mouse pointer at the time the menu was opened. The *“All Peaks”* option clears all labels from the recording.
- **Plot Type:** It changes the way the recording is displayed. There are four possible options:
 - **‘Average’** is a standard average of all sweeps, shown as a single waveform.
 - **‘Split Sweep’** shows the two internal buffers of the recording as two overlapping averages. Useful to evaluate the repeatability of an individual waveform.
 - **‘Plus-Minus’** shows the difference between the buffers in an A minus B average. Useful to evaluate the level of noise of a waveform.
 - **‘Spectral’** shows the waveform in the frequency domain. The waveform is split into two curves, one for the repeatable energy, and one for the non-repeatable energy (*noise*).
- **Show Labels:** This sub-menu has options for hiding/showing the labels on a recording.
- **Show Text:** This sub menu has four possible options to control the visibility of recording information:
 - **‘Next to Label’** shows the amplitude and latency information next to the peak labels.
 - **‘Side’** shows recording and peak label information in a text field to the side of the waveform.
 - **‘Below’** shows recording and peak label information in a text field under the waveform.
 - **‘OFF’** hides all information, this does not affect peak labels.
- **Print Parameters:** This option will toggle whether the recording acquisition parameters are printed when the page is sent to print.
- **Scaling:** This option works like the scaling for the entire page in the [\[Set Page\]](#) menu, however it only applies to the active recording. It allows the scaling to be set to **‘Display Window’**, **‘Post Stimulus region’**, or **‘Special’**. Setting it to special will activate the following two options. Scaling only works when the page is set to normalized mode.
- **Scaling Start:** When scaling is set to **‘Special’**, this option defines the start of the scaling normalization region.
- **Scaling End:** When scaling is set to **‘Special’**, this option defines the end of the scaling normalization region.
- **Send to Page:** Selecting one of the options in the fly-out menu will move the active recording to the selected report page.
- **Clear:** This option clears the active recording from the page. It does not delete the data.
- **Clear All Selected:** This option clears all selected recordings, selected report items, and the active recording from the page. It does not delete the data.
- **Color:** Gives options for coloring a recording differently. This may make it easier to identify or differentiate one recording from another.
- **Close:** Closes the menu.

File Name: EMLA80B.2 Info.	▶
Peak Latency	▶
Mark Peak	▶
Mark Other Peak...	
Remove Peak	▶
Plot Type: Average	▶
Show Labels: ON	▶
Show Text: Side	▶
Print Parameters: ON	▶
Scaling: Display Window	▶
Scaling Start: 0.03 msec	
Scaling End: 24.70 msec	
Send to Page	▶
Clear	
Clear All Selected	
Color	
Close	

Report item context menu (Text)

This menu appears when right-clicking on a text report item:

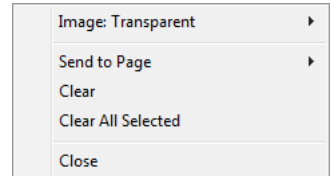
- **Send to Page:** Selecting one of the options in the fly-out menu will move the active recording to the selected report page.
- **Clear:** This option clears the active report item.
- **Clear All Selected:** This option clears all selected recordings, selected report items, and the active recording from the page. It does not delete the data.
- **Edit:** Opens the text editor. Keep in mind that dynamic fields can be modified, but modifications will be lost next time the field updates.
- **Close:** Closes the menu.



Report item menu (Image)

This menu appears when right-clicking on an image report item:

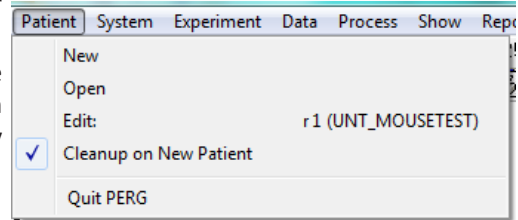
- **Image:** Allows to select between transparent and non-transparent. When set to transparent, the white pixels of the bitmap image will become see-through.
- **Send to Page:** Selecting one of the options in the fly-out menu will move the active item to the selected report page.
- **Clear:** This option clears the active report item.
- **Clear All Selected:** This option clears all selected recordings, selected report items, and the active recording from the page. It does not delete the data.
- **Close:** Closes the menu.



Main Menu

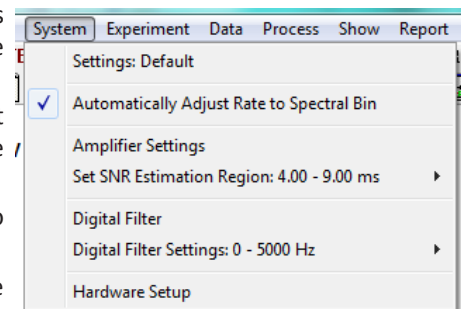
Patient

- **[New]**: Opens the Patient Demographics window, ready to accept information for a new patient file.
- **[Open]**: Opens the Patient List window.
- **[Edit]**: Opens the Patient Demographics window with the information for the current patient file, allowing changes to the information.
- **[Cleanup on New Patient]**: When active, all recording pages will be cleared when a patient file is opened or a new patient file is created. When inactive, the information will remain in place. This option is active by default.
- **[Quit PERG]**: Closes the software.



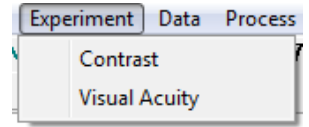
System

- **[Settings]**: Shows the current system settings file under use. Clicking on this option will open the settings file load window, listing the settings files in the 'Settings_PERG' folder.
- **[Automatically adjust Rate to Spectral Bin]**: When checked, will adjust available stimulation rates such that available rates will fall exactly into the spectral bins defined by the sampling rate.
- **[Amplifier Settings]**: Opens the EEG and Amplifier window. This is equivalent to pressing the **[EEG & Amp]** button on the control panel.
- **[Set SNR Estimation Region]**: Used to define the start and end times for the SNR calculation region, where the SNR value is shown on the Indicator Bar. This option requires the use of the system password.
- **[Filter]**: Turns ON and OFF the on-line digital filter. This filter affects recordings as they are acquired, the effects of this filter cannot be undone. Filter settings are defined on the next option.
- **[Digital Filter Settings]**: This item has two sub-menu items for setting the low pass and high pass filter settings. These filters are not active until the **[Filter]** option is turned ON.
- **[Hardware Setup]**: Opens the Hardware Setup window. Refer to the Launch Pad manual for more information about this window.



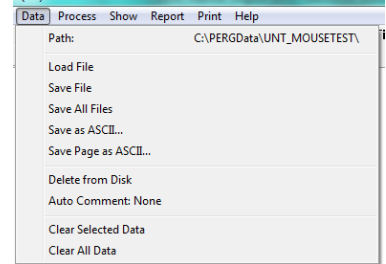
Experiment

- **[Contrast]**: Runs through all contrast values in a single recording, saving individual contrast values as sub-block data.
- **[Visual Acuity]**: Runs through all spatial resolutions in a single recording, saving individual spatial frequency data as sub-block data.



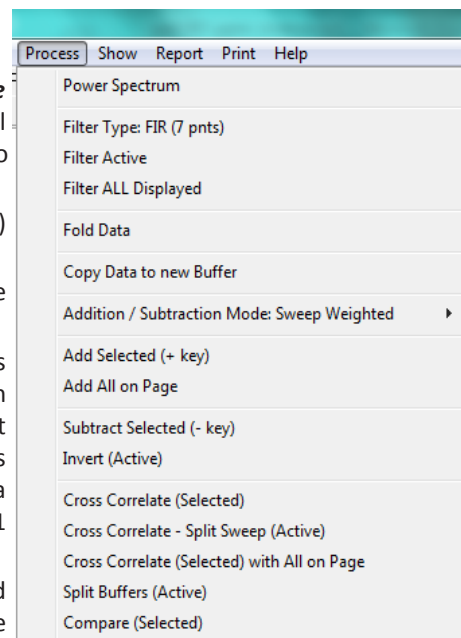
Data

- **[Path]**: Points to the current location of the patient file, where the acquired data is being saved to.
- **[Load File]**: Opens the Load File window.
- **[Save File]**: Saves the currently selected recording.
- **[Save All Files]**: Saves all recordings, on all pages.
- **[Save File as...]**: Allows saving the recording under a different recording type or name.
- **[Save as ASCII]**: Saves the currently selected recording to a ASCII file, a tab delimited text file.
- **[Save Page as ASCII]**: Saves all recordings on the page to an ASCII file, a tab delimited text file.
- **[Delete From Disk]**: Deletes the selected recording from the hard drive. Caution, this operation cannot be undone.
- **[Auto Comment]**: Clicking on this option opens a comment field window. The comment entered in the field will be added to all acquired recordings from this point on, until the field information is changed, or the software re-started.
- **[Clear Selected Data]**: Removes the selected recordings from the page. Use the **[Ctrl]** key on the keyboard to select multiple recordings. This option only clears the data from the screen, it does not delete saved data from the disk. Make sure all recordings are saved before clearing them from the screen.
- **[Clear All Data]**: Clears all the recordings from the page. It does not delete saved recordings from the disk. Make sure all recordings are saved before using this option.



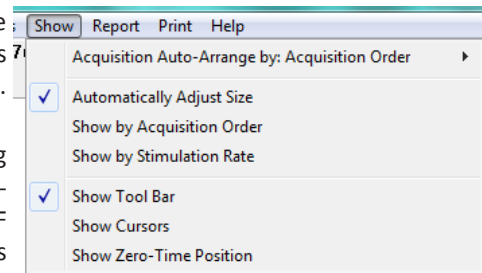
Process

- **[Power Spectrum]:** This option shows a power spectrum window for the selected recording.
- **[Filter Type]:** Shows the selected filter type, clicking on this item will bring up the filter selection window. Filter types are FIR *“Finite Impulse response”* (smoothing filter), spectral band pass, and spectral notch. See the following two options to apply the selected filter to waveforms.
- **[Filter Active]:** Applies the selected filter type to the active (selected) waveform.
- **[Filter ALL displayed]:** Applies the selected filter type to all the waveforms on the current page.
- **[Fold Data]:** For the PERG recordings, the acquisition buffer will always display two adjacent responses (for Steady-State acquisition). When recording responses at transient reversal rates, highlight the transient wave for and select the fold data option to average the two responses into a single transient for waveform analysis. After selecting the Fold data option, the software will attempt to automatically apply the P1 component marker.
- **[Copy Data to New Buffer]:** Creates a second copy of the selected waveform. The copy is temporary and it must be saved manually using the Data menu, or by saving a report, if it needs to be kept.
- **[Addition/Subtraction Mode]:** Allows the selection of the form of addition or subtraction to be used. Microvolt weighted will treat the recordings as a single sweep. Sweep weighted will take into consideration the number of sweeps contained in each recording and add or subtract the waveforms proportionally.
- **[Add Selected]:** Adds the selected recordings into a new recording buffer, using the mode chosen in the previous option. To select multiple recordings hold down the **[Ctrl]** key while choosing the recordings. The new recording needs to be saved manually.
- **[Add All on Page]:** Adds all the displayed recordings into a new buffer, using the mode chosen. The new recording needs to be saved manually.
- **[Subtract Selected]:** Subtracts one recording from another using the selected mode. The operation is a simple A minus B, where A is the active recording (dark filled recording handle) and B is the secondary selection (grey filled recording handle).
- **[Invert]:** Flips the active recording upside-down.
- **[Cross Correlate]:** Compares two recordings over the specified time period. Two recordings must be selected by holding the **[Ctrl]** key. Cursors must be active to define the comparison time start and end (see Show menu).
- **[Cross Correlate - Split Sweep]:** Compares the active recording internal buffers to one another over the specified time period. Cursors must be active to define the comparison time start and end (see Show menu).
- **[Cross Correlate With All on Page]:** Compares the active recording to all the others on the page over the specified time period. Cursors must be active to define the comparison time start and end (see Show menu).
- **[Split Buffers]:** This option will separate the two internal recording buffers for the active waveform into two separate waveforms.
- **[Compare]:** This option compares a left ear recording to a right ear recording



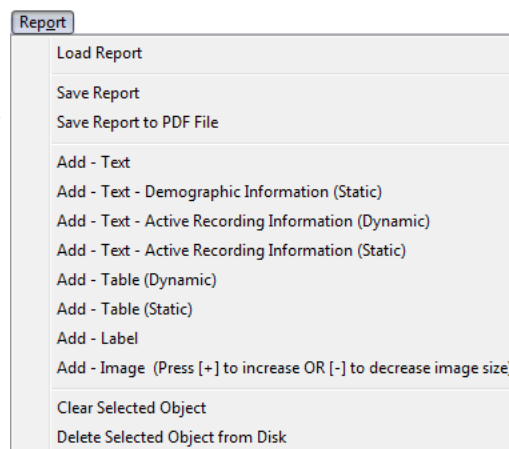
Show

- **[Acquisition Auto-Arrange by]:** This item will open a sub-menu with multiple options for auto-arranging data on the screen. While one of these options is selected, the software will update the display as each recording is completed. Selecting '**None**' will prevent the software from auto-arranging the responses.
- **[Automatically Adjust Size]:** This option makes the waveform's vertical spacing adjust based on the number of waveforms acquired and the type of auto-arrange currently selected. The more waveforms, the smaller. Turning it OFF will keep the vertical spacing the same regardless of the number of waveforms acquired, or loaded. This option is set to ON by default.
- **[Show by Acquisition Order]:** Arranges the responses automatically by the order in which they were acquired, from first to last. This option will separate the left and the right channels on a split screen layout.
- **[Show by Stimulation Rate]:** Arranges the recordings automatically by the rate of stimulation, from high to low. This option will separate the left and the right channels on a split screen layout.
- **[Show Toolbar]:** This menu item will show or hide the toolbar. A check mark next to it indicates the current status.
- **[Show Cursors]:** This item will show/hide the vertical cursors. A check mark next to it indicates the current status. Cursors are necessary for cross correlation calculations, these calculations use the time window in between the cursors for the calculations.
- **[Show Zero-Time Position]:** This option shows a vertical bar at the zero time on the horizontal scale. This option is useful when the zero position is not shown due to modified plot start and end times.



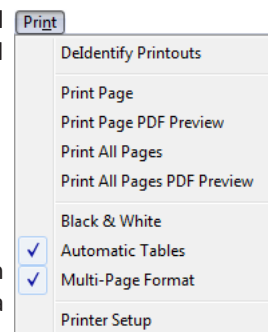
Report

- **[Load Report]:** Opens the Load File window with a list of previously saved report files.
- **[Save Report]:** Opens the Save File window to allow the storing of a report file. Saved reports include all recordings and other report items, and their positions on all pages.
- **[Save report to PDF File]:** Opens a report into a PDF file, this is equivalent to printing all pages to a PDF file.
- **[Add - Text]:** Opens the text editor, then places the entered text on the page. This text can be edited at any time.
- **[Add - Text - Demographic Information (Static)]:** Opens the text editor, pre-filled with the patient demographics information. The information can be edited before it is committed to the page.
- **[Add - Text - Active Recording Information (Dynamic)]:** Places the information about the selected recording on the page. This information will update automatically if the recording changes, such as when placing peak labels. These type of text fields should not be edited manually since all manual edits will be lost when the field updates. This field can be moved to another report page and it will still keep the link to the original data.
- **[Add - Text - Active Recording Information (Static)]:** Places the information about the selected recording on the page. This information will not update if the recording changes. These type of text fields can be edited manually.
- **[Add - Table (Dynamic)]:** Places the information about all the recordings on a page. This information will update automatically if the recordings change, such as when placing peak labels. These type of text fields should not be edited manually since all manual edits will be lost when the field updates. This field can be moved to another report page and it will still keep the link to the original data.
- **[Add - Table (Static)]:** Places the information about all the recordings on a page. This information will not update if the recordings change. These type of text fields can be edited manually.
- **[Add - Label]:** Opens the text editor, then places the entered text on the page. This text field will only show the first line of text, even if additional text is entered.
- **[Add - Image]:** Opens the Load File window with the list of Bitmap images contained in the patient folder. These may include audiograms from the SmartEP-ASSR program, DP-Grams from SmartDPOAE, or audiograms from Intelligent VRA.
- **[Clear Selected Object]:** Removes the selected report object from the screen. It leaves the report item on the patient folder for future use.
- **[Delete Selected Object from Disk]:** Removes the selected report object from the hard disk. Caution: This operation cannot be undone.



Print

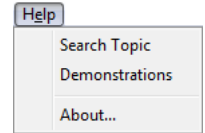
- **[Deidentify Printouts]:** When this option is active, patient identifying information will be removed from printouts, useful for sending information to third parties while still complying with HIPAA.
- **[Print Page]:** Sends the current report page to the windows default printer.
- **[Print Page PDF Preview]:** Saves and opens the current report page as a PDF file.
- **[Print All Pages]:** Sends all report pages to the windows default printer.
- **[Print All pages PDF Preview]:** Saves and opens all report pages as a single PDF file.
- **[Black & White]:** Changes the printing method from color to black and white. This option should be activated when using a black and white printer; printing a color report to a black and white printer may cause some colors to become a hard to see shade of gray.



- **[Automatic Tables]**: Switches On and OFF the display and printing of automatic tables at the bottom of the page.
- **[Multi-Page Format]**: When activated, a single report page may print to multiple sheets of paper if the recordings take too much space. If this option is not active, some information may be truncated, but it will be constrained to a single sheet of paper.
- **[Printer Setup]**: Opens the windows printer setup window. See your printer documentation for details.

Help

- **[Search Topic]**: Opens the online help file.
- **[Demonstrations]**: Opens the demonstration window.
- **[About]**: Opens the software version information window.



Additional Windows

EEG & Amplifier window

12



The EEG and Amplifier window can be opened by choosing [System > Amplifier Settings] from the main menu, or clicking on the [EEG & Amplifier] button on the control panel. Clicking the [OK] button on this window will close the window and commit any changes made to the settings.

EEG graph

Located at the top left of the window, the graph shows the live EEG (*in blue*) as it is being detected by the amplifier. Above it, there is an indicator to point out if the amplifier is turned ON or OFF. The horizontal time scale is based on the selected [Time] setting in the control panel. The vertical microvolt scale is based on the selected Gain. Clicking on the [Pause] button will freeze the EEG graph until resumed.

Rejection level and region

The pink color area pictured in the EEG graph is a representation of the Rejection Level and region. This area can be adjusted using the Open-Close Level slider to the right of the graph, and the Region buttons at the bottom of the graph. Generally, the rejection area should be set to start slightly after stimulus onset, and end after the expected response time. A level of 31% is usually adequate, however it should be adjusted based on current conditions. The actual microvolt level of the rejection is dependent on the Gain setting and the actual value can be seen at the bottom of the channel settings section.

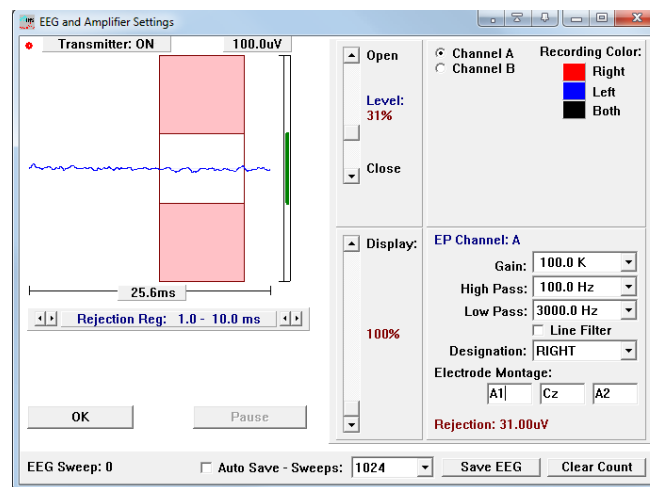


Fig. 31. - EEG and Amplifier Window

Channel selection

At the top right of the window, the channel selection area will show radio buttons corresponding to each available EP acquisition channel. Selecting a channel from the list will show the channels settings and assigned recording colors for that channel. Some channels, such as the Eye-Blink channel, will not appear unless the correct modality is active. Note that the recording colors can be set for each channel independently.

Channel settings

The bottom right of the window shows the Channel Settings panel. These settings are channel independent and show the values corresponding to the currently selected channel. Changes to these values are only applied after clicking [OK] to close the window; although they can be changed while acquisition is occurring, changes will not apply until the next time the acquire button is pressed. The following parameters are available:

- **Gain:** Determines the amount of gain applied by the amplifier to the incoming signal. To change this value, simply choose a different option from the drop-down menu. All values are given in the thousands (k).
- **High Pass:** Determines the hardware filter to be used as a high pass cutoff, filtering out all frequencies below the selected value. To change this value, simply choose a different option from the drop-down menu. All values are

given in hertz.

- **Low Pass:** Determines the hardware filter to be used as a low pass cutoff, filtering out all frequencies above the selected value. To change this value, simply choose a different option from the drop-down menu. All values are given in hertz.
- **Line Filter:** When this box is checked, the power line filter is activated, creating a notch filter at the line frequency (60 or 50 Hz, depending on your country or area). This filter should only be used when power line noise is a problem.
- **Designation:** This item determines how each channel behaves. The available options on USB and USB Jr. systems include: Right, Left, ON, and OFF. The USBLite systems will have as options Left-Right and Midline. Refer to the SmartEP User Guide for usage examples.
- **Electrode Montage:** These fields are used for reference only and have no bearing on the actual results. This information will be added to the recording information and can be used for archiving if the exact electrode locations need to be recorded for future reference.

EEG sweeps

Some researchers may wish to save the incoming EEG. The incoming data is stored in an internal buffer equal to the selected number of sweeps from the drop down box, then cleared once it reaches the full count. Saving the EEG data can be done automatically by clicking on the **[Auto-Save]** box, resulting in files containing the number of sweeps selected in the drop-down. It can also be done manually by clicking the **[Save EEG]** button, saving the last block of EEG data to disk and resetting the counter. The **[Clear Count]** button can be used to manually reset the count if needed. If you wish to use this data, contact IHS for information about the data format so it can be read by your application.

Power Spectrum window

The power spectrum window can be opened from the SmartEP main menu by clicking on **[Process > Power Spectrum]**. The second option, **[Power Spectrum (Multi-Buffer Advanced Module)]**, opens the same window, but concatenates sequential recording buffers that were acquired using the Advanced Auditory modality.

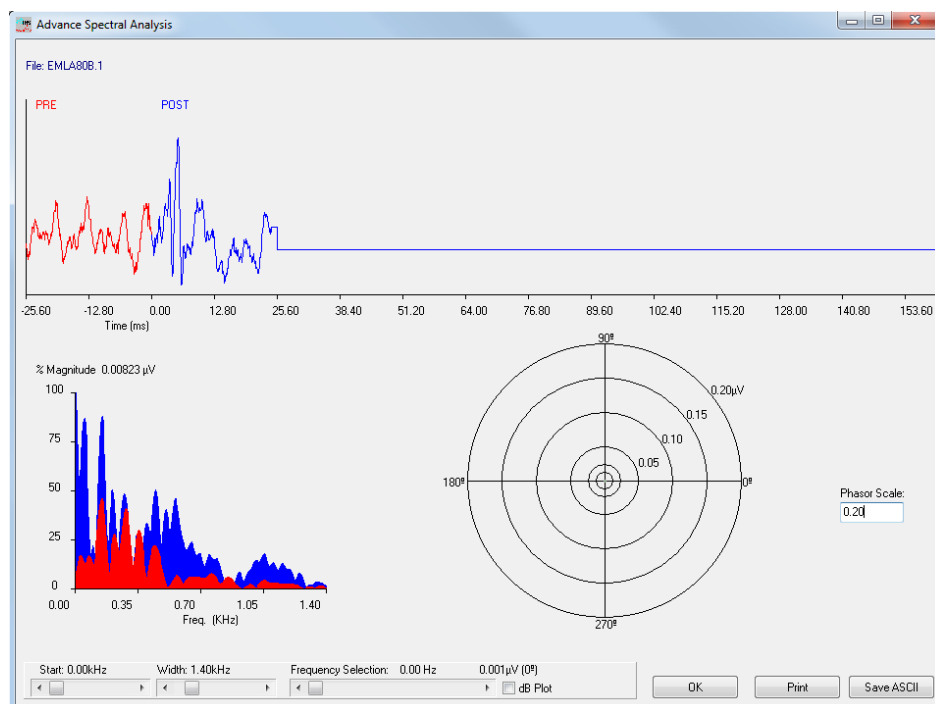


Fig. 32. - Power Spectrum Window

Areas of the window include:

- **Recording Name:** shown at the top left of the window for reference.
- **Time Domain Graph:** shown on the left half of the window. It includes the entire recording, the pre-stimulus region is marked in **Red**. The post-stimulus region is marked in **Blue**.

- **Frequency Domain Graph:** shown on the right half of the window. It depicts the resulting FFT as a percentage of power measured in Pico-Volts squared. The **Blue** region is the post-stimulus region. The **Red** region is the pre-stimulus region.
- **[OK]:** closes the window.
- **[Print]:** sends the current graphic to the default printer.
- **[Save as ASCII]:** Opens a window to save a text file with the FFT information.
- **[dB Plot]:** This check box changes the display from a '**% power**' to a dB scale.
- **[Start]:** The value shows the start of the graph, it can be changed by moving the slider under it.
- **[Width]:** The value represents the resolution of the FFT, it can be changed by moving the slider under it. Moving it to the right will decrease resolution, while moving to the left will increase it.



Appendices



Hardware errors

My USB system is not responding

- Is the power LED of the USB box illuminated? If not, check that the switch is in the ON position, the power cable is properly connected, the isolation transformer is connected, and all cables are in good condition. If necessary, disconnect the isolation transformer and connect a different electrical appliance to the outlet to verify that the outlet is in good condition and currently providing power. Note that the USB Lite hardware does not have an ON/OFF switch.
- Is the USB cable connected properly, and is the Computer connection and Online LED's illuminated? Check both ends of the cable for proper connection and the cable itself for any possible damage.
- Was the SmartEP program started before the USB box was turned ON? If so, exit the SmartEP program, Turn the USB Box OFF, then back ON and then restart the SmartEP program.
- Was the installation of the software completed properly? Turn the USB system's Switch to the ON position and run System DSP Test from the System menu on the IHS Launch Pad. It is important that you do so in that order. If you can only see the General and Driver tabs, then the computer cannot communicate with the USB box. Check the cables and power connections again; retest the system.
- Otherwise, go through the tabs pressing the buttons to perform tests on the system. If an error arises, contact IHS with that information.

The software loses communication with the hardware after a while

Make sure all USB Root hubs of the computer are not set to conserve power when the computer goes into idle state. In Windows XP this can be changed by accessing the properties of each USB Root Hub from the windows device manager. In windows Vista and Windows 7, the power settings for USB Root Hubs can be switched from the advanced power management settings.

If this still occurs, make sure the unit is not overheating (*too hot to touch*). If it is overheating on its own, discontinue use immediately and contact IHS Technical Support for immediate assistance.

The power LED is blinking

The system must be inspected by IHS Immediately. Turn the system OFF and contact Technical Support for details about shipping the system back to IHS for inspection.

Error "USB Connection not Found" appears at startup

The problem may be that the USB box was not turned ON or connected to the computer before software was started. The software needs to verify the connection and download programs to the USB box before it can run. To fix this problem, close PERG, turn ON the USB box and restart the software. If this does not solve your problem, there must be something wrong with the USB box or its connections. Follow the steps in the **"My USB System is not responding"** question to find the problem.

EEG and amplifier

The EEG waveform is flat

- Is the transmitter switch in the ON position?
- Is the transmitter box receiving power? Move the switch to one of the impedance test positions and verify that the LEDs light up. If not, verify that the power is properly connected.
- Is the fiber optic cable plugged correctly at both ends?
- Unplug the fiber optic cable from the transmitter. Are the sockets where the cable was connected emitting a red light? If not, contact IHS.
- Is the fiber optic cable kinked or bent? Kinks or bends in the fiber optic cable may cause the inside of the cable to break; this will cause the data to stop flowing from the transmitter. Always store the fiber optic cable in a loose circular manner.

To test the internal integrity of the fiber optic cable, reconnect the cable to the transmitter and turn the transmitter on. Disconnect the cable from the receiver and verify that the red light can be seen at the other end of the cable. If you cannot see any changes, the cable may be broken.

- Is the socket where the fiber optic cable is connected to the system broken? This may cause external lighting to enter the transmission receiver, creating too much noise for the signal to be clear.
- Are the electrodes attached correctly?
- Are the transducer silicon tubes or foam tips occluded?

The EEG is too noisy

- Check the EEG and Amplifier rejection ratio. Press EEG and Amplifier in the control panel and move the level slider to read between 15 and 30 microvolts for a standard ABR. The rejection level is displayed in the bottom-right information panel. Do the same for all channels that will be used for acquisition.
- Check the high pass and low pass filters in the EEG and Amplifier Dialog Box. Make sure the filters are close to the recommended settings for the type of recording that you wish to acquire.
- Is the transmitter away from other electrical devices? If not, move it away from any electrical machinery that may be causing interference, such as computer monitors or electrical outlets. The EEG and Amplifier dialog box should show the signal as close to a flat line as possible when the patient is not connected.
- Are the fiber optic cables kinked or bent? If they are, they may be broken inside and may need to be replaced. To test the internal integrity of the fiber optic cable, reconnect the cable to the transmitter and turn the transmitter on. Disconnect the cable from the receiver and verify that the red light can be seen at the other end of the cable. If you cannot see the light, the cable may be broken. Always store the cable in a loose circular manner.
- Is there a 60 Hz (*or 50 Hz, depending on your location*) signal artifact? Try turning the Notch filter ON.

Electromagnetic Interference (noise)

Intelligent Hearing Systems hardware has been designed to prevent electromagnetic interference with other electrical equipment. However, due to the nature of some of the recordings acquired, it is necessary to take some precautions to avoid interference. Electromagnetic Interference received by the IHS hardware has no physiological effects on the patient being tested. However, the interference could lead to inaccurate recordings, therefore leading to possible misdiagnosis. The existence of electromagnetic interference can be observed by the amount of noise received in the signal. If the noise is too high, you should:

- Move the electrode lead cables away from any possible source of interference.
- Position the leads so that they do not cross other cables, preferably away from the patient's body.
- Make sure the patient and hardware components are not close to electrical outlets or any other electrical equipment, if possible.
- When not using shielded electrode leads, braiding the leads may help reduce the effects.
- Move the amplifier away from any older CRT monitors as they may cause interference.

Other basic things that should be done prior to the patient arriving:

- Make sure all equipment is plugged into an isolation transformer; including the PC and all of its attached peripherals.
- Make sure the isolation transformer is plugged into an outlet with earth ground. In many locations, including hospitals, the earth grounded outlets are marked with a green dot.
- If using a cart with metal parts on it, make sure the cart is grounded using the grounding screw on the isolation transformer. Carts will usually have a screw specifically for this purpose.
- The furniture where the patient will rest should not have metal parts touching the patient or any of the cables attached to the system. Metal furniture should also be grounded, if possible.
- Avoid patient contact with heating pads or cooling pads while acquiring.
- Turn off any non-essential equipment in the immediate area while acquiring, including those that have wireless features.

Waveforms

Waveforms are missing

The software is set to automatically auto-save every recording. It is possible to turn this setting OFF; however, it needs to be done manually every time the software is started. Most likely this is the result of acquiring data under the wrong patient, or when a patient file was not yet created. Creating the patient file mid-acquisition will also have the same effect. Although the software warns to enter new patient information when none is loaded, it is the users responsibility to change the patient file or create a new one in between tests.

- Locate the "**C:\IHSData\XX**" folder and see if any of the files found in there have a creation date corresponding to the time when the patient was tested. If they do, create the patient in the software, then move the data from the "**XX**" folder to the newly created patient folder; where the name of the folder is the patient file given identifier.
- Locate the folders for patients that were tested just prior to the one in question. Explore the folder and verify the file creation time stamps to see if they coincide with the time of testing for the patient. If they do, create a new patient file in the software then copy the data into this new folder; where the name of the folder is the patient file given identifier. Load and verify that this is indeed the data corresponding to this patient.

Waveforms are not very repeatable

There are multiple causes for this:

- The waveform amplitude is too low. If there is no response from the patient, or there is a problem with either the recording electrodes or the stimulator; it may be that the information shown is simply noise and not a real waveform. Look at the PP amplitude of the waveform in the indicator bar, while the waveform is selected. If the value is below 0.3 μV , The recording most likely contains only noise. Use the Loopback test procedure to verify the unit is working properly.
- There is too much electrical noise. If the latencies and amplitudes seem to vary in large ranges, there is probably too much noise getting accepted causing variability on the response. Fixes include all the suggestions given in **“Electromagnetic interference (noise)”** on page 99.
- Small variability in latency and intensity can be attributed to patient noise (*EEG*), as it is a normal part of the process. This kind of noise is most likely unavoidable, patients that are not in a relaxed state will show this effect more often. Extended acquisition (*more sweeps*) will close the gap between one response and another; however, this comes at the cost of time, and it may not be needed at all when evaluating the results.
- If testing over multiple sessions, even in the same session sometimes, ambient noise conditions will change, resulting in variability of the responses. As before, this can only be solved by extending the average.

There is no zero time on the horizontal scale

There are two possibilities:

- When showing the pre-stimulus region, it is possible to choose a value that will make the zero time position of the scale disappear. To find the zero time, activate the **[Show Zero-Time Position]** option from the **[Show]** menu.
- If the scale starts at a positive number other than zero, it can be set to start at zero again by choosing **“0”** in the **[Plot Start Time]** option of the **[Set Page]** button.

Peak marking

The peak label is getting replaced

When the user attempts to place a peak label too close to an existing peak label, the software assumes that the previous label is being replaced. To prevent replacement, place the label in a different location, then drag the top and bottom markers of the label into position.

The peak label is not being placed

- If no peaks are showing at all, it could be that the waveform has been set to hide all peaks. To resolve it, right click on the recording, then from the context menu select **[Show Labels > ON]**
- If the peak was accidentally marked too close to the left of the screen, it may have been placed outside of the display area. Either remove all peaks and place them again, or change the Plot Start Time to view the area where the peak was placed.

The label button on the tool bar is not working

When placing a label using the tool bar, make sure to click the button only once. When active, the label button text will turn red. Place the mouse pointer at the time position where you wish to place the marker then click. There is no need to click directly on the waveform, as the software will pick the current mouse pointer time position as the placement location.

My custom label is not on the list

Custom labels need to be added to the list, then the list needs to be saved. Failing to save the list will cause the label to be missing from it next time the software is started. Labels placed on recordings will remain, even if they are not saved on the list.

I can see latency but I can't find the amplitude

When a peak marker is placed, there are two markers added, a top arrow pointing down and a bottom triangle pointing up. Latency is calculated based on the position of the top arrow, while amplitude is calculated by the voltage difference between the top and bottom marker positions. When a label is placed, both markers are placed at the same location, yielding an amplitude of 0. Move the bottom marker to the next peak or valley, as applicable, so that the software can calculate the amplitude.

Printing

The data table is not printing

Automatic tables is turned OFF. Click on [\[Print > Automatic Tables\]](#) to reactivate the option.

The data table does not show peak information

The recordings were acquired in the wrong modality. The program prints table information based on the recording type; recording with the wrong type will not show the information on the table. To correct this, select the affected recording then click on [\[Data > Save File As\]](#) and choose the appropriate option from the list. The correction may need to be applied to more than one recording.

Recordings are too light on a black and white printer

Some printers will map colors to light shades of gray when printing a color image, in some cases, they may be too light to see. To fix this click on [\[Print > Black & White\]](#) from the main menu. With this option active, the program will send a plain black and white image to print instead of a color one, avoiding printing to shades of grey.

Font error appears when printing or saving to PDF

This error occurs when a report item containing text has been brought from another computer, or when a font has been deleted from the system since the file was generated. To correct, look for text fields on the report pages, select them, edit them by right clicking on their handle and selecting [\[Edit\]](#) from the context menu, and change the font to one available on this computer by clicking on the [\[Font\]](#) button.

